N93FWP01MTUS

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

WEED MANAGEMENT PLAN

PREPARED FOR:

Montana Department of Fish, Wildlife and Parks
Region 2
3201 Spurgin Road
Missoula, MT 59801

PREPARED BY:

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June 1993

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EXECUTIVE SUMMARY

INTRODUCTION

This plan summarizes weed management concerns and identifies control methods for lands administered by the Montana Department of Fish, Wildlife and Parks (FWP) in west-central Montana (Region 2). The plan emphasizes an Integrated Pest Management approach which considers all site conditions and prescribes cultural, mechanical, biological and chemical weed management practices. Treatment area priorities, control objectives, control methods and monitoring programs are identified.

This plan encompasses 8 state parks, 62 fishing access sites and FWP regional headquarters (Table 1). These sites have a combined acreage of approximately 4560 acres.

EXISTING WEED CONDITIONS

Many sites administered by FWP in Region 2 have been invaded by knapweed and other common weeds due to soil disturbance from various activities. Important factors related to early weed invasion include the close proximity of FWP sites to water and roads and the frequent visitation by people and vehicles. The most common weed on Region 2 FWP lands is spotted knapweed. Russian thistle, sulfur cinquefoil, leafy spurge, common dandelion and cheatgrass are other common weeds on these sites.

PAST WEED CONTROL EFFORTS

Past weed control efforts in FWP Region 2 have included mowing, weed-whipping, hand pulling and chemical herbicide applications. The principal target of these efforts has been spotted knapweed. Over half of these lands have had some type of past weed control.

SITE CONDITIONS

Site conditions vary in rainfall, soils, presence of surface water, depth to groundwater and other important factors. Many sites however have sufficiently similar conditions to develop common guidelines for weed control and environmental protection.

The local climate is dry and cold with an annual precipitation of 13-15 inches on most sites. Most soils are rocky, sandy, porous, low in organic matter, weathered from a variety of rock types and deposited by moving water (alluvium). Most sites include surface water (streams or lakes) and also have shallow groundwater underlying at least a portion of the area. Vegetation is dominated by grassland and dry forest types.

WEED MANAGEMENT OPTIONS

Alternative Control Methods for pest management include cultural, mechanical, biological and chemical techniques. **Cultural** weed control methods concentrate on establishing and maintaining healthy, vigorous, desirable plants which can resist pest invasion. Cultural control also seeks to minimize soil disturbance so weeds have less opportunity to become established. **Mechanical** control methods physically remove undesirable plants or plant parts, especially seed heads. **Chemical** weed control methods use herbicides kill weed pests directly. **Biological** control methods mainly consist of releasing organisms (usually insects, pathogenic microbes or predators) which attack the pest. These methods are not usually designed to control the pest in a short time period but to reduce its numbers to more tolerable levels over longer periods.

MANAGEMENT ACTIONS

The FWP Region 2 weed management plan emphasizes an Integrated Pest Management (IPM) approach. Weed management is a complex task and requires complex solutions with the flexibility to change as new information is gathered, new control methods become available and new weed problems arise. This plan follows a step by step format with the ability to be modified as necessary.

WEED CONTROL STRATEGIES FOR EACH WEED

Objectives and strategies for each individual weed are defined, generally falling into five categories: prevention, eradication, reducion, containment or tolerance.

WEED CONTROL METHODS

Tools for controlling weeds emphasize an Integrated Pest Management approach and include cultural, mechanical, biological and chemical methods. Cultural and mechanical control methods are the preferred method where labor and budgets allow. Chemical weed control is employed more extensively in the early stages of this weed management plan to provide effective initial control at a reasonable cost. Over time, the goal of this plan is to replace chemical control with cultural and mechanical control methods. FWP will also continue to support development of biological weed control methods.

WEED MANAGEMENT ZONES

Sites are divided into zones with similar physical and ecological conditions and which can receive similar weed control treatments. Examples include water quality protection zones, sensitive species zones, human use zones and general weed management zones. Each FWP site is mapped into weed management zones.

SITE-SPECIFIC WEED CONTROL PLANS

A procedure has been established to complete site-specific weed control plans for all sites to inventory present conditions, identify threatened, endangered and sensitive (TES) species, delineate weed management zones, assess treatment priority and prescribe specific weed control measures.

SITE TREATMENT PRIORITY LIST

Criteria are established for prioritizing FWP sites in Region 2. Limited manpower and budgets will not allow immediate weed control on all sites.

Additional information provided in this plan includes treatment of species of special concern, monitoring, record-keeping, contracted services, notification, emergency spill response and education.

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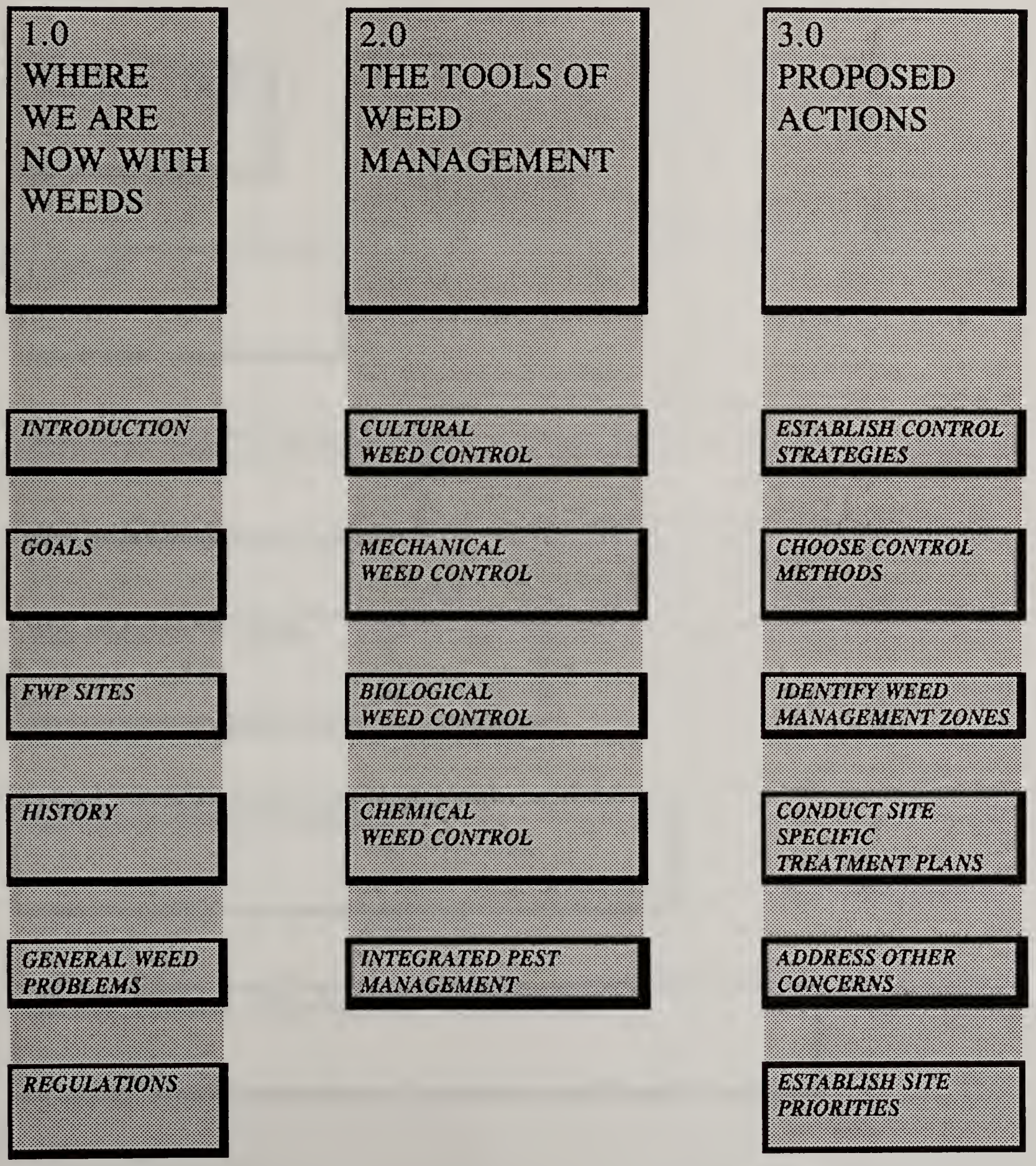

1.0 WHERE WE ARE NOW WITH WEEDS

INTRODUCTION

GOALS

FWP SITE CONDITIONS

HISTORY OF WEEDS

GENERAL WEED PROBLEMS

REGULATIONS AND AGENCY GUIDELINES

1.1 INTRODUCTION

This plan summarizes weed management concerns and identifies control methods for selected lands administered by the Montana Department of Fish, Wildlife and Parks (FWP) in west-central Montana. The plan emphasizes an Integrated Pest Management approach which considers all site conditions and prescribes cultural, mechanical, biological and chemical weed management practices. Land management activities are encouraged which prevent soil disturbance and weed establishment. Treatment area priorities, control objectives, control methods and monitoring programs are identified.

1.2 GOALS

The goals of this plan are to:

- Comply with existing weed control laws.
- Reduce the influence of weeds on native plants and animals.
- Accomplish weed control without significant adverse environmental effects.
- Reduce impacts on adjacent lands from weed infestations on FWP lands.

1.3 FWP REGION 2 SITE CONDITIONS

This plan covers 8 state parks, 62 fishing access sites and Region 2 headquarters (Table 1). These sites have a combined acreage of approximately 4560 acres. Elevations range from approximately 2600 - 6000 feet. Annual precipitation is 13-20 inches on most sites but ranges up to 30-35 inches in a few cases. Most soils are rocky and sandy, porous, low in organic matter, weathered from a variety of rock types and deposited by moving water (alluvium).

Many of these sites have sufficiently similar conditions to develop common guidelines for weed control and environmental protection. Most sites include surface water (streams or lakes) and also have shallow groundwater underlying at least a portion of the area. Vegetation is dominated by grassland and dry forest types. A wide variety of terrestrial and aquatic wildlife use these areas.

A "typical" FWP site:

- Access road
- Parking area
- Surface water body (lake or stream)
- Restrooms
- Boat ramp or boat access (half of sites)
- Concentrated public use

Table 1 illustrates important characteristics of these sites. Also presented are the general extent and type of weeds noted in a 1982 inventory.

TABLE 1. WEED AND SITE INVENTORY SUMMARY

AREA Site	TOTAL ACRES	INFESTED ACRES	WEEDS PRESENT	PAST CONTROL	SW[1]	SGW[2]	SOIL CLASS	BOAT RAMP
BITTERROOT								
Bass Creek	22.5	12	SK-H, CT-M	CMWS	*	*	GR, S	N
Bell Crossing	60	20	SK-H, CT-L	WS	*	*	GR,S	U
Buck House Bridge	3	.5	SK-S	N	*	*	GR,S	N
Chief Looking Glass	13	3	SK-M LS-L	MCWS	*	*	GR, S	U
Florence Bridge	7.45	1	SK-L	W	*	*	GR, S	U
Fort Owen State Park	1	.3	SK-L D-L	S, G, W			GR, S	N
Hannon Memorial	52	20	SK-M	MWSC	*	*	GR,S	U
Lolo	55	10	SK-M	N	*	*	GR, S	N
Painted Rocks State Park	293	120	SK-M	WSC	*	*	GR, S	I
Poker Joe	12	4	CT-L, SK-L	SCW	*	*	GR, S	N
Tucker Crossing	256	126	SK-L, BT-S	M, GCSW	*	*	GR, S	I
Wally Crawford	1.68	.01	SK-S	MW	*	*	GR, S	I
Whittecar Rifle Range	30	20	SK-H	S, G, W			GR, S	N
Woodlot	20	5	SK-S	N	*	*	GR,S	N
Woodside Bridge	3.5	1	SK-M	WS	*	*	GR,S	I
BLACKFOOT								
Belmont Creek	20	2.2	SK-S	G	*	*	GR, S, SI	N
Browns Lake	58	15	SK-M, CT-M, LF-S	M, C	*	*	GR, S, SI	I
Cedar Meadows	3.5	.2	CT-L, SK-L	W, S	*	*	GR, S	U
Daigles Eddy	20	5	SK-S	G			GR, S	N
Harry Morgan	65	10	CT-L, SK-L	M, S,W	*	*	GR, S	U
Johnsrud Park	18	3	SK-H	C, W, S	*	*	GR, S	U
K. Ross Toole	29	10	SK-M	N	*	*	GR, S	N
Lincoln Canyon	7.5	3	SK-S CT-S	N	*	*	GR, S	N
Marco Flats	1.5	.5	SK-S	WS	*	*	GR, S	N

TABLE 1. (CONT.)

AREA Site	TOTAL ACRES	INFESTED ACRES	WEEDS PRESENT	PAST CONTROL	SW[1]	SGW[2]	SOIL CLASS	BOAT RAMP
Monture Creek	110	50	SK-H	M, WCGS	*	*		U
Nine Mile Prairie	14.5	12.5	SK-H, LS-S	W	*	*	GR, S	N
Red Rock	2	.5	SK-S	G	*	*	GR, S	N
River Bend	40	10	LS-S, CT-S, SK-L	WG	*	*	GR, S	U
River Junction	120	50	SK-S	G	*	*	GR, S	U
Roundup	3	1	SK-H	W	*	*	GR, S	R
Russel Gates Memorial	41	14	SK-M, LS-S	S, W,C	*	*	GR, S	U
Sheep Flats	40	4	SK-L	G	*	*	GR, S	N
Sperry Grade	5	2	SK-S	MW	*	*	GR, S	U
Thibodeau	25	5	SK-S	G	*	*	GR, S	N
Whitaker Bridge	2	.5	SK-S	G	*	*	GR, S	N
Clearwater								
Clearwater Crossing	4	3	SK-M	M, SCW	*	*	GR, S	U
Harper Lake	112	45	SK-M	M, SCW	*	*	GR, S	U
Placid Lake State Park	31	6	SK-L, CT-L	W, SC	*	*	GR, S, SI	I
Salmon Lake State Park	42	5	SK-L CT-L	CMWS	*	*	GR, S	I
Upsata Lake	11	5	SK-M	MCW	*	*	GR, S,	U
Lower Clark Fork								
Big Pine	19	10	SK-H CT-L	CMWS	*	*	GR, S	N
Council Grove State Park	188	85	SK-H	M, W, SC	*	*	GR, S	N
Cedar Creek	3.5	2	SK-M	N	*	*	GR, S	N
CYR Bridge	10	8	SK-H	MCW	*	*	GR, S	R
Deep Creek	136	75	SK-M	N	*	*	GR, S	I
Dry Creek	2	2	SK-H	N	*	*	GR, S	I

TABLE 1. (CONT.)

AREA Site	TOTAL ACRES	INFESTED ACRES	WEEDS PRESENT	PAST CONTROL	SW[1]	SGW[2]	SOIL CLASS	BOAT RAMP
Erskine	426	220	LS-M, SK-H, CT-M	M, CG	*	*	GR, S	N
Forest Grove	5.5	2	SK-M, LS-S	M, SW	*	*	GR, S	I
Forks	5	1	SK-M	N	*	*	GR, S	N
Frenchtown Pond	41	35	SK-H	M, SCW	*	*	GR, S	N
FWP Headquarters	14.5	10	SK-H CT-S	MSCW	*	*	GR, S	N
Kelly Island	648	350	SK-SCT-S LS-S	M, WSC	*	*	GR, S	I
Natural Pier	87	30	SK-M	WMS	*	*	GR, S	N
Petty Creek	25	10	SK-M, TF-L	M, W, SC	*	*	GR, S	I
St. Johns	3	2	SK-L	M, W	*	*	GR, S	U
Tarkio	8	6	SK-M	N	*	*	GR, S	I
Tarkio East	6	4	SK-H	N	*	*	GR, S	N
Quartz	11	8	SK-M	N	*	*	GR, S	N
Upper Clark Fork								
Anaconda Stack	12	1	SK-S CT-S	N	*	*	GR, S	N
Bearmouth	3.5	2	SK-M	N	*	*	GR, S	N
Beavertail Hill	65	30	SK-H	M, SCGW	*	*	GR, S	N
Beavertail Pond	53.5	53.5	SK-H	CW	*	*	GR, S	U
Fish Trap	80	2	SK-S, CT-S	M, SC	*	*	GR, S	N
Kohrs Bend	8	5	SK-S, CT-S	GMWS	*	*	GR, S	N
Lost Creek	477	25	CT-S SK-S	C	*	*	GR, S	N
Medicine Tree	418	250	SK-S CT-S	GC	*	*	GR, S	N
Milltown Dam	5	2	SK-M	N	*	*	GR, S	N
Schwartz Creek	14	2	SK-M	N	*	*	GR, S	U
Sha-Ron	2	1	SK-L, L	M, SCW	*	*	GR, S	U
Tamarack	4	2	SK-S, CT-S	N	*	*	GR, S	N
Turah	17.5	6	SK-H	M, W, S	*	*	GR, S	U
Welcome Creek	107	25	SK-S	N	*	*	GR, S	N

TABLE 1. FOOTNOTES AND EXPLANATIONS

1 (SW) - Surface water at the site (yes or no)

2 (SGW) - Shallow ground water table (< 10 ft)

WEEDS
N - None
BT - Bull Thistle
CT - Canada Thistle
D - Dandelion
LS - Leafy Spurge
SK - Spotted knapweed
TF- Dalmation Toadflax

CONTROL EFFORTS
N - None
M - Mowing
I - Irrigation
G - Grazing
S - Soil sterilant
C - Other chemical herbicides
W - Weedeater

BOAT RAMPS
I - Improved boat ramp
N - None
R - Raft landing
U - Unimproved boat ramp

COVERAGE
L - Low (1-10%)
S - Scattered (<10% cover)
M - Moderate (10-25%)
H - High (>25%)

SOIL CLASSES
GR - GRAVELLY
S - SANDY
SI - SILTY
C - CLAYEY

1.4 HISTORY

Exotic (non-native) weedy plants have been noted in western Montana throughout this century. In the past few decades, some of these plants have become significant components of local vegetation communities, actually dominating some sites. The displaced native species are often more desirable for wildlife food and cover, for erosion control and for visual quality. Weeds may reduce vegetation biodiversity directly (the number of species) and therefore limit the diversity of dependent wildlife species.

Many sites administered by FWP were invaded by knapweed and other common weeds due to soil disturbance by various activities. Important factors related to weed invasion include the close proximity of FWP sites to water and roads and the frequent visitation by people and vehicles. These activities promote site disturbance and seed dispersal.

Past weed control efforts at these sites have included mowing, weed whipping, hand pulling and chemical herbicide applications. The principal target of these efforts has been spotted knapweed. Over half of these sites have had some type of past weed control.

Small chemical applications have been made by FWP maintenance personnel, especially soil sterilant in parking areas. One larger scale application was contracted to a private applicator. In a few cases, cooperative efforts have been made with neighboring landowners to coordinate weed control. FWP Region 2 currently has a licensed pesticide applicator under contract.

1.5 GENERAL WEED PROBLEMS

Weeds are present on all FWP sites but the number and total coverage vary considerably. The most common weed on local FWP lands is spotted knapweed. Canada thistle, sulfur cinquefoil and leafy spurge are other common noxious weeds. Other common weeds which are not listed as noxious include dandelion, dalmation toadflax and cheatgrass.

Weed densities at FWP sites range from scattered individual plants to a nearly complete cover of individual weeds, especially spotted knapweed. Infested sites include parking areas, boat ramps, roadsides, streambanks, lake shores and other disturbed areas.

A weed inventory was conducted by FWP maintenance personnel in 1985 (see table 1). This inventory was not comprehensive and did not include all species currently listed as noxious in Montana (sulfur cinquefoil).

Exotic plants such as spotted knapweed dominate many FWP lands which were originally much more diverse and abundant plant communities. These weedy areas generally provide less valuable forage and cover for most wildlife species. Weeds also provide less protection from soil erosion by wind and water. Where weeds occupy streambanks and lake shores, they may provide much less stability and erosion control than the original vegetation (Hansen 1988).

For the purpose of this report, weeds are considered as all exotic (non-native) plants. This definition includes introduced grasses such as Kentucky bluegrass, quackgrass, and cheatgrass. Also included are erosion control and reclamation grasses such as crested wheatgrass, hard fescue, sheeps fescue, and others. These exotic grasses are considered weeds because they are invasive, persistent, and often out-compete native plants. None of these grassy weeds are listed as "noxious weeds" and very little direct attempts are made to control their influence or spread. Management may be limited to reseeding areas of weedy grasses to native species when they are disturbed for construction or other reason.

1.6 REGULATIONS AND AGENCY GUIDANCE

Montana has recognized the damaging effects of weeds in laws and regulations such as the Montana Weed Control Act. The Montana list of recognized noxious weeds is presented in Appendix A. Individual counties in Region 2 have adopted local weed management plans. Other state and federal regulations affect weed control programs such as the Montana Pesticides Control Act.

State and local laws require landowners to control noxious weeds. However, in some cases these regulations are not strictly enforced especially in the spotted knapweed areas of western Montana. The Montana Noxious Weed Control Act (Title 7, Chapter 22 Sections 7-22-2101 through 7-22-2153 and rules 4.5.201 through .5.203) requires control of specific weeds:

"It is unlawful for any person to permit any noxious weed to propagate or go to seed on his land, except that any person who adheres to the noxious weed management program of his district or who has entered into and is in compliance with a noxious weed management agreement is considered to be in compliance with this section" (7-22-2116 MCA).

FWP has general policies which concern weed management including the department's vision statement:

"to provide for the stewardship of the fish, wildlife, parks and recreational resources of Montana, while contributing to the quality of life for present and future generations"

FWP also has developed specific weed management policies. A 1983 statewide weed control management plan established the objective:

"to prevent, to the extent feasible, the reproduction and distribution of agriculturally undesirable plant species throughout department land or from department lands onto adjacent lands"

The statewide plan provides guidance for considering weed control which emphasizes conditions and control efforts on adjacent lands, noxious list status and available resources. Appendix B lists laws and regulations related to weed control in Montana.

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The statewide plan provides guidance for considering weed control which emphasizes conditions and control efforts on adjacent lands, noxious list status and available resources. Appendix B lists laws and regulations related to weed control in Montana.

2.0 THE TOOLS OF WEED MANAGEMENT

Alternative Control Methods for pest management include cultural, mechanical, biological and chemical techniques.

2.1 CULTURAL AND MECHANICAL CONTROL METHODS

Cultural weed control methods concentrate on minimizing soil disturbance and maintaining healthy, vigorous, desirable plants which can resist weed invasion. Mechanical control methods include partial or total destruction of weeds. Plants may be hand pulled, plowed under, mowed or weed-whipped. Special efforts are made to prevent seed from developing and maturing. Examples of cultural and mechanical controls suitable to FWP sites include:

Prevention

Minimizing soil disturbance and maintaining healthy, vigorous vegetation provides the best defense against weed invasion. Weeds take advantage of space created by disturbance. The goal of this method is to reduce factors which affect plant competition with weeds such as grazing, cultivation, traffic, burrowing animal activity and other soil disturbances. Construction activities must be planned to minimize soil disturbance and provide for revegetation as quickly as possible. Topsoil, gravel and sand sources must be weed-free.

Revegetation

When plant communities are completely disturbed by construction or are entirely dominated by weeds, complete revegetation is required. Revegetation of weedy areas requires significant initial expense to eliminate existing weeds, prepare a seedbed and re-plant but usually produce dramatic results. In radically disturbed areas, it is essential to revegetate as quickly as possible. Topsoil should be salvaged and replaced on the disturbed site as soon as possible to encourage native species to sprout from seed, rhizomes and other plant part in the salvaged soil.

Digging, Hand Pulling and Cultivation

These methods are appropriate for some areas, where infestations are small and plants are small. Large-scale cultivation requires sizable acreages accessible by farm-type machinery to be cost-effective. Complete removal of all plant parts, especially roots, is difficult and varies by weed species, soil moisture conditions and other factors. These methods are most often used where chemical control is not possible such as near water, or when sensitive species are present which may be affected. These methods are applicable to FWP sites but require tremendous manpower. They might best be considered for volunteer group efforts.

Mowing and Weed Whipping
Mowing is a common tool used to improve appearances but does not eliminate the weed plants themselves. Mowing may however be very effective at reducing seed production especially with weeds that produce only one brief crop of seed. Some weeds such as spotted knapweed have a very long season of seed production and it is difficult to eliminate all seed production. Knapweed may flower to a limited extent below mower height.

Mowing height is an important part of weed control. Low mowing heights favor weed germination and growth by exposing the soil to more sunlight and stressing the mowed vegetation. Mowing heights of 4-6 inches or more should be used where possible.

Mowing, especially early in the season may harm native grasses. Where native grasses, especially bluebunch wheatgrass, are an important component of the plant community, mowing should be delayed until grasses mature.

Irrigation
Irrigation can be used to control some weeds. Spotted knapweed is very specifically adapted to dry site conditions and may be controlled or eradicated by applying irrigation water. Irrigation can be used to help establish vigorous stands of desirable plants quickly and encourage root development. Irrigation may also stimulate the weed growth so it must be used with consideration of site specific conditions.

Fertilization
Weeds are adapted to very harsh site conditions and may have a competitive advantage on some sites, especially where soil disturbance has occurred. Fertilization is sometimes used to provide desirable species with the needed nutrition to better compete with weeds. Fertilization may also stimulate weed growth so it is usually used only when nutrient levels are too low for the growth of desired plants.

Mulching
Mulching with plant materials, landscaping fabric and other substances is an effective control method for small areas if installed and maintained properly. Mulching may also improve soil conditions such as aeration, water and nutrient holding capacity and infiltration.

Traffic control
Since weeds have the advantage in disturbed, compacted, trampled conditions, implementation of traffic controls will reduce weed invasion and spread.

User education
Most weed control efforts require the cooperation of informed users and efforts must be made to educate them about goals, methods and results. Cultural controls can be very effective if the public cooperates. Mechanical control programs are so labor and cost intensive that they may only be possible with the aid of volunteer organizations and

individuals. Biological methods need public sector funding support for research and releases. Public education is needed to foster the understanding and support for biological control programs. Public education must continue on the use of chemical control methods to address issues of weed control, environmental impact and human health.

Health Effects
Cultural and mechanical weed control methods have health risks including back and other muscle strain from pulling weeds, using hand tools or performing other manual labor tasks. Health risks are also associated with equipment use.

2.2 BIOLOGICAL CONTROL METHODS

Biological control methods mainly consist of releasing organisms (usually insects, pathogenic microbes or predators) which attack the pest. These are often cultured forms of naturally occurring pest enemies. These methods are not usually designed to control the pest in a short time period but to reduce its numbers to more tolerable levels over longer periods (USDA 1989).

Although current biological methods are not effective at controlling local weeds, progress is encouraging and deserves continued support (Story 1979). A list of local biological weed control agents is presented in Appendix C. These biological agents include moths, flies, nematodes, beetles, gallflies, weevils and fungi which specifically attack six of our most common local weeds.

Biological control is not a "quick fix" but should provide substantial benefits over the long term. Cultural and chemical controls may still be needed to achieve initial control and for large periodic outbreaks. Long term costs of biological control should be low as environmental equilibrium is reached. Short-term costs will be substantial to investigate and commercially produce needed control organisms. FWP will continue to encourage research on biological control and will participate in control organism release opportunities whenever possible.

Livestock grazing, especially using sheep and goats, has been identified as a potential "biological" control agent for leafy spurge and other weeds. The general effectiveness of this method is the subject of debate. Careful monitoring of grazing animals, target weeds and nontarget plants is requires to evaluate success and prevent unplanned damage to desirable vegetation.

2.3 CHEMICAL CONTROL METHODS

Chemical weed control methods use herbicides to kill weed pests directly. Concerns with chemical control include human health risks and environmental impacts, especially

to water supplies, wildlife and nontarget plants. Chemical control is usually the most effective, easiest and least expensive for short-term control.

2.31 CHEMICAL PESTICIDES

Over the past half-century, chemical pesticides have been developed to effectively and inexpensively control a variety of pests including weeds, insects and fungi. While the benefits of chemical herbicides are obvious, some have been found to have serious consequences on human health and the environment. Pesticide manufacturers have responded with attempts to develop products that are:

* more pest-specific (kill the pest and not other organisms)
* less toxic to humans, birds, fish and other animals
* less likely to impact the environment especially water quality

Some of the major issues related to chemical pesticide use are discussed below. Detailed information on the specific herbicides proposed for use is presented in Appendix D.

Control Effectiveness

Properly used chemical herbicides are usually very effective against their target pests. Variation in effectiveness occurs due to rates of application, environmental conditions, skill of the applicator, condition of the equipment and other factors.

Costs

Chemical pesticides are relatively inexpensive to apply. Many commercial herbicide applications cost $10-30/acre. These costs are usually a small fraction of the cost for mechanical eradication such as hand pulling.

Health Effects

A definitive evaluation of health effects from pesticides is beyond the scope of this plan. The long-term health effects of chemical pesticides continue to be researched. Short-term health effects can be serious for sensitive individuals. Health effects are most commonly reported among pesticide applicators. Due to uncertainty over health and environmental effects, the goal of this plan is to reduce or eliminate the use of chemical pesticides over time. Our discussion of health effects includes toxicity, carcinogenicity and mutagenicity.

Pesticide Toxicity

Toxicity tests are used as standard reference experiments to evaluate potential harm to mammals and other organisms. Toxicity tests on mammals are segregated into acute, subchronic and chronic categories based on the length of exposure to the pesticide.

Acute tests evaluate the effects of large dosages in a short time period. Observations are conducted over a span of days to weeks. The most often referred to indices for pesticide toxicity is the median lethal dose (LD50) and the median lethal concentration (LC50). This is defined as the dose or concentration which is lethal to 50 percent of the treated population (expressed in milligrams of

compound ingested per kilogram of body weight). Various rating systems are used to discuss relative toxicities of pesticides. The US Environmental Protection Agency (EPA) has category guidelines for acute and subchronic toxicity which are used on pesticide labels (Table 2). Labels are required under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

Table 3 illustrates the relative toxicity of common pesticides and other substances including those used historically by FWP. Note that many of these pesticides are rated less toxic than table salt and aspirin according to the standardized tests. Comparison with table 2 reveals that the herbicides proposed for use by FWP are slightly to moderately toxic. This does not guarantee that their total health effect is benign but may illustrate relative risk.

TABLE 2. TOXICITY RATINGS FOR ACUTE ORAL DOSES IN HUMANS*

Toxicity Rating	Classification	LD50 (mg/kg)	Probable Lethal Oral Dose for Average Adult Human
1	Super Toxic	< 5	< 7 drops
2	Extremely toxic	5 to 49	7 drops to 1 tsp.
3	Very toxic	50 to 499	1 tsp. to 1 oz.
4	Moderately toxic	500 to 4999	1 oz. to 1 pint
5	Slightly toxic	5000 to 14999	1 pint to 1 qt.
6	Practically non toxic	> 15000	> 1 qt.

* From USDA Agriculture Handbook 633

TABLE 3. TOXICITY OF COMMON PESTICIDES AND REFERENCE MATERIALS

CHEMICAL (TRADE NAME)	USE	ORAL* RAT LD50	ORAL*** HUMAN LD50
PARATHION	Insecticide	3-13	.0005 - .002
NICOTINE (TOBACCO)	Tobacco product	50-60	.008 - .009
DDT	Pesticide - banned	115	.017
PARAQUAT	Insecticide	138	.02
2-4,D (component of CURTAIL)	Broadleaf herbicide	300-1000	.05 - .15
ATRAZINE	Herbicide - kills grass	660 - 5100	.1 - .8
DICAMBA (BANVEL)	Broadleaf herbicide	1000	.15
ASPIRIN	Pain reliever	1000-2000	.15 - .3
MALATHION	Insecticide	1375	.2
PICLORAM** (TORDON)	Broadleaf herbicide	2000 - 4000	.3 - .6
SODIUM CHLORIDE (TABLE SALT)	Condiment	4000 - 5000	.6 -.8
CLOPYRLID** (STINGER)	Broadleaf herbicide	>5000	>.7

IMAZAPYR** (ARSENAL)	Non-specific herbicide	>5000	>.7
GLYPHOSATE** (ROUNDUP)	Non-specific herbicide	5600	.8

* Lethal dose in MG/KG of body weight for 50% of the test animals (rats) - the lower the number, the more toxic the substance.

** Pesticides currently used or proposed for use in FWP Region 2.

*** Estimated lethal dose in pounds for a 150 pound person - estimated from male rat data using a conversion factor for mg/kg to lbs/150 lbs of .00015018 These numbers are not precise but provide a relative idea of lethal doses.

Carcinogenicity and Mutagenicity

Chronic impact studies expose a test subject to a pesticide for a majority of its life span to determine the effects of long-term, low-level exposure. The potential for mutagenicity, carcinogenicity and teratogenicity is evaluated. These tests are very complex in relation to human biological systems and potential influences. There can be no doubt that pesticides have had serious health effect for some individuals who are especially sensitive. It is likely that the true effects on the general population will not be known for some time due to the relative short period of historical use and the length of time needed to determine conclusive trends. Table 4 illustrates activities needed to increase an average persons risk of cancer by one-in-one million based on current studies.

Current data suggest that heath risks from pesticides can be significant especially for sensitive individuals. At the same time, it seems theoretically possible to reduce pesticide risks to levels equivalent to other common risks. This is accomplished by proper storage, use and disposal including the use of protective clothing. Since health data is inconclusive, it seems prudent to minimize exposure to pesticides.

Environmental Effects

Environmental effects other than those on human health are another serious concern when considering chemical herbicide use. Impacts have included groundwater and surface water contamination as well as direct effects on wildlife, especially fish and birds. Other, less obvious effects on beneficial insects, crops and other non-target organisms have been the subject of lengthy debate. Pesticides are evaluated in terms of their persistence, potential for movement and pathways or mechanisms of breakdown.

Persistence

Pesticides are degraded by physical, chemical and biological mechanisms. They are also exposed to metabolitization, decomposition, biodegradation and photodegradation. Pesticide persistence is usually expressed in half-life, which may range from one day to several years. Most pesticides are degraded to very low levels in soil after several weeks or months. Some are designed for multi-year persistence and may last several years.

TABLE 4. GENERALIZED SUMMARY OF ENVIRONMENTAL INFLUENCES WHICH INCREASE CANCER DEATH RISK BY ONE IN ONE MILLION. *

SOURCE OF RISK	AMOUNT OF EXPOSURE
Herbicide worker spraying:	2,4-D (Component of Curtail): 137 days. picloram (Tordon): 11,236 days. glyphosate (Roundup): 41,667 days.
Cosmic rays:	One transcontinental round trip. Living 1.5 months in Colorado. Camping at 15,000 ft for 6 days.
Eating and drinking:	40 diet sodas (saccharin). 6 lbs of peanut butter (aflatoxin). 180 pints of milk (aflatoxin).
Other:	Smoking 2 cigarettes. 2.5 months in masonry rather than wood building. 1/7 of a chest x-ray using modern equipment

* From: 1989. USFS Lolo National Forest. Draft Environmental Impact Statement. Noxious Weed Management Plan.

Potential for Movement

Pesticides are transported through the environment as solids liquids and gases. Pesticides in the environment are absorbed, adsorbed, accumulated, degraded, diluted, inactivated and mobilized. Their ultimate fate is heavily influenced by the type of pesticide, the application rate, and environmental conditions at the time. The volatility, solubility, absorption and chemical activity characteristics of pesticides also affect movement. Electrochemical and absorption qualities of pesticides are important due to interaction with soil organic matter and clay particles. Solubility in water gives a preliminary indication of mobility. However, further study is required to determine degradation pathways and products. Extensive research has been conducted on most common pesticides to establish environmental pathways and final fate.

Water Quality Protection

Water quality is a major concern for FWP. Most FWP sites have both surface water and shallow groundwater. Soils are usually sandy and gravely with high infiltration and hydraulic conductivity rates. Some FWP sites have drainage paths, especially near boat ramps, which may transport chemicals to water.

2.32 LEGAL CONCERNS

Debate continues in the medical and biological communities over the human health and environmental effects of herbicides. Despite this indecision, the courts have continued to decide these same issues in the form of judgments and damage awards. Potential liability must be a consideration in any pesticide management plan. Manufacturers have attempted to reduce liability by producing less toxic, less persistent and more pest-specific pesticides. Landowners and applicators attempt to minimize liability by developing and following pest management plans which include personnel training, proper use and storage, public notification and other factors.

2.33 PESTICIDE STORAGE, HANDLING, USE AND DISPOSAL

The worst herbicide problems usually result from spills during storage, handling, use and disposal. When pesticides are applied to plants and soils they degrade relatively quickly and seldom penetrate deeply in soil. Most pesticides are broken down and adsorbed in the surface foot of soil. However, when large volumes of herbicides are spilled at one site, the capacity of the soil to degrade it is exceeded. This is a special concern at FWP properties due to proximity to surface and groundwaters and due to special concerns over fish and wildlife impacts.

Care must be exercised in handling and mixing chemicals. Equipment must be in good condition and inspected regularly. Drivers of vehicles must be especially vigilant since many spill are secondary to minor accidents. Chemicals should be mixed as needed in amounts that will be used entirely. Apply excess chemicals on suitable areas. Mix and rinse equipment at locations with acceptable collection and treatment or recycle collected mix back into the tank for mixing liquid. Other options may include rotating these activities on vegetated surfaces so excessive amounts do not percolate through the soil. Establish a spill response plan coordinated between appropriate departments and outside organizations.

2.34 PESTICIDE LABELS

Pesticide labels are an important component of chemical pesticide use and safety. Labels are booklet format documents supplied with each container of product. The label contains detailed information to support four important goals of the regulation process for pesticide use including Identification, Protection of Health and the Environment, Special Practices and Legal Requirements. Pesticide labels have the force of law and should be an integral part of a weed management program. Appendix D details the components of pesticide labels and their use.

2.35 APPLICATOR LICENSES AND RECORDS

Applicators of restricted use pesticides, such as Tordon, must have a license from the state government. To obtain a license the applicator must take training courses and pass an exam for the specific type of pest problems that they will be treating. In order to retain that license the applicator must earn re-certification credits in government approved courses.

The law also requires that the applicator make and retain records of their use of pesticides. The application records must be submitted to the state department of agriculture on at least an annual basis. These records must be made available to state investigative officers at any time following a pesticide use complaint. All aspects of applicator licensing, re-certification training, and record keeping regulations administered by the state government are in-turn supervised by the United States Environmental Protection Agency.

2.4 INTEGRATED PEST MANAGEMENT

Integrated pest management (IPM) is a flexible combination of cultural, mechanical, biological and chemical control methods. The goal of most IPM programs for weeds is to meet vegetation goals while decreasing chemical use over time.

The success of IPM is dependent on the ability to monitor pest problems and to keep accurate records of outbreaks and the conditions that promote them, the treatments that are effective and costs or tradeoffs in their use.

3.0 PROPOSED MANAGEMENT ACTIONS

ESTABLISH CONTROL STRATEGIES FOR INDIVIDUAL WEEDS

ESTABLISH SITE PRIORITIES FOR TREATMENT

IDENTIFY WEED MANAGEMENT ZONES TO APPLY DIFFERENT PRESCRIPTIONS

SELECT CONTROL METHODS TO BE USED IN FWP REGION 2

COMPLETE SITE- SPECIFIC PLANS FOR ALL SITES BEFORE TREATMENT

3.0 PROPOSED MANAGEMENT ACTIONS

FWP Region 2 proposes to initiate a weed management plan emphasizing an Integrated Pest Management (IPM) approach. Weed management is a complex task and requires complex solutions with the flexibility to change as new information is gathered, new control methods become available and new weed problems arise. To address this complex issue, we have broken the task down into steps which add up to a comprehensive approach. Each of these steps can be adapted and improved upon independently as budgets and manpower allow.

STEP 1 - IDENTIFY A WEED CONTROL STRATEGY FOR EACH WEED. In this step we decide what to do with each weed (prevent, eradicate, reduce, contain or tolerate).

STEP 2 - SELECT WEED CONTROL METHODS.
In this step we select the tools we will use to control weeds emphasizing an integrated Pest Management approach and including cultural, mechanical, biological and chemical methods.

STEP 3 - IDENTIFY WEED MANAGEMENT ZONES.
In this step we divide up our sites into zones we will apply similar weed control treatments to.

STEP 4 - COMPLETE SITE-SPECIFIC WEED CONTROL PLANS.
In this step, site-specific plans are completed for all sites to inventory present conditions, identify TES species, delineate weed management zones, assess treatment priority and prescribe weed control.

STEP 5 - PRIORITIZE THE SITES FOR TREATMENT AND TREAT.
Since we operate under limited budgets, which sites shall receive weed control treatment first.

3.1 WEED CONTROL STRATEGIES

In this step each weed is assigned a control strategy mainly based on the physiological characteristics of the individual weed. Control strategies include: prevent, eradicate, reduce, contain and tolerate (USDA 1989). Control strategies depend on many factors including potential impact on FWP values, potential for spread and difficulty of control. These same factors are considered in listing weeds as noxious and so all noxious weeds are given high control priority. Definitions of the control strategy classes are as follows:

- **PREVENT** - Prevent the establishment of new noxious weed species through education, early detection, and transportation controls.

- **ERADICATE** - Attempt to eliminate noxious weeds from FWP sites. Eradication efforts will continue as long as the weed is present.

- **REDUCE** - Prevent seed production and reduce weed coverage. Prevent the weed from dominating other vegetation at the site but accept low levels infestations.

- **CONTAIN** - Prevent weed spread beyond the treatment or infestation area. Tolerate weeds within established infestations, but suppress or eradicate spread.

- **TOLERATE** - Accept established infestations that will likely spread to ecological limits. Eradicate new invasions where easy.

Proposed weed control strategies are presented in Table 5 for common local weed species. FWP will continue to evaluate the implications of weed control programs for wildlife, native plants and other concerns.

TABLE 5. WEED CONTROL STRATEGIES FOR REGION 2[1]

PREVENT - CLASS 1 - PRESENT A THREAT TO FWP PROPERTY

COMMON NAME	SCIENTIFIC NAME
Common crupina	Crupina vulgaris
Dyers woad	Isatis tinctoria
Eurasian water milfoil	Myriophyllum spicatum
Purple loosestrife	Lythrum salicaria
Rush skeletonweed	Chondrilla juncea
Yellow star-thistle	Centaurea solstitialis

ERADICATE/PREVENT - CLASS 2

Leafy spurge[2]	**Euphorbia esula[3]**	**(eradicate new infestations)**
Whitetop (Hoary cress)	Cardaria draba	

REDUCE/CONTAIN - CLASS 3

Canada thistle[2]	**Cirsium arvense**
Dalmation toadflax[2]	Linaria dalmatica
Diffuse knapweed	Centaurea diffusa
Field bindweed[2]	Convolvulus arvensis
Spotted knapweed[2]	**Centaurea maculosa**
Sulfur cinquefoil[2]	Potentillia recta

CONTAIN/REDUCE - CLASS 4

Bull thistle	**Circium vulgare[3]**
Broad-leaved plantain	Plantago major
Common dandelion	**Taraxacum officinale**
Common tansy	Tanacetum vulgare
Field pennycress	Thalaspi arvense
Houndstongue	Cynoglossum officinale
Lamb's-quarters	Chenopodium album
Mustards	Brassicaceae family
Pineapple weed	Matricaria matricarioides
Knotweed	Polygonum spp.
Purslane	Portulaca oleracea
Redroot Pigweed	Amaranthus retroflexus
Round-leaved mallow	Malva rotundifolia
Sheperd's purse	Capsella bursa-pastoris
Smartweed	Polygonum spp.

TOLERATE - CLASS 5

Cheatgrass	Bromus tectorum
Common timothy	Phleum pratense
Crested wheatgrass	Agropyron repens
Kentucky bluegrass	Poa pratensis
Quack grass	Agropyron repens
Other introduced grasses	

1 Explanation of classes on following page
2 Designated noxious weeds
3 Bolded species were noted in the weed inventory

TABLE 5 (CONT.) - EXPLANATION OF CLASSES

PREVENT - Class 1 weeds are threatening FWP sites and occur on nearby lands. They have not been detected on FWP lands or only in very small numbers. It is possible to keep out infestations at this stage when only a few, small plants are present. Control efforts are very cost effective with this class. The weed control goal on these sites is to prevent the establishment of these weed species.

ERADICATE/PREVENT - Class 2 weeds occur in very small infestations and have the potential to spread rapidly. Control efforts are very cost effective with this class. The weed control goal on these sites is to prevent the establishment of these weed species and eradicate existing plants.

REDUCE/CONTAIN - Class 3 weeds are already abundant and have the greatest visual, economic and environmental impacts. These weeds occur across large acreages of Region 2 and widespread effective control is unlikely in the immediate future. The weed control goal on these sites is to contain and reduce populations when possible.

CONTAIN - Class 4 weeds are abundant on scattered sites in Region 2, are not regarded as being as serious a problem or present special control problems. The weed control goal on these sites is to contain and reduce populations when they occur in association with Class 3 weeds.

TOLERATE - Class 5 weeds are common on FWP sites and most are well-established non-native grasses which are not considered weeds by much of the general public. These species however compete with native species and may not provide habitat, cover and food sources equivalent to what they have replaced. These species may be tolerated while more traditional weed problems are addressed. A long-term goal will be to replacement these species with those native to FWP sites. The short-term goal will only include reseeding sites to native species which are disturbed by construction or other activities.

3.2 WEED CONTROL METHODS

Weed control in would include cultural, mechanical, biological and chemical methods. The magnitude of the initial control attempt would require tremendous manpower and expense using cultural and mechanical methods. It is therefore expected that chemical control will be an important component of the IPM strategy in initial weed control efforts. After an initial chemical application, the goal of this program is to reduce chemical use and emphasize cultural and mechanical contol methods.

3.21 CULTURAL AND MECHANICAL

Cultural and mechanical weed control will continue to be a major part of the Region 2 program. On some sites, and especially where manpower is available, these methods may provide adequate weed control. Cultural and mechanical methods to be used in FWP Region 2 include:

- Prevention
- Revegetation
- Digging/ Hand-pulling
- Mowing/weed whipping
- Traffic Control
- User education

Since it is unlikely that FWP budgets will allow sufficient manpower to provide weed control in Management Zone 1 (Water Quality Protection MA), volunteer groups will be encouraged to assist the department. Sportsmen, students, church groups, scouts and others will be solicited for these projects.

3.22 BIOLOGICAL

FWP Region 2 will encourage continued developments of biological weed control agents in Montana. Region 2 will participate in releases of biological agents when possible and will cooperate with research projects by other organizations.

3.23 CHEMICAL

The herbicides picloram (Tordon), clopyralid (Stinger), glyphosate (Roundup) and imazapyr (Arsenal) will be used on FWP property in Region 2. These herbicides are some of the least toxic, persistent and mobile available. They may be used alone or in approved combinations. Appendix D contains chemical labels and material safety data sheets (MSDS) for each of these herbicides . Other herbicides, approved for use by the EPA and licensed for use in Montana, may be considered in the future. New chemicals proposed for use will be reviewed by FWP resource staff before approval. Appendix E contains chemical weed control guidelines for the most common weeds in Region 2.

Herbicides will be applied according to label directions, management zone goals, threatened, endangered and sensitive species concerns, and other site specific constraints required by this plan. Restricted-use chemical applications will be supervised by an applicator licensed in the State of Montana. This licensed applicator will be a FWP employee if applications are made by FWP. Contracted applications will also be supervised by a licensed contract applicator.

Site-specific plans will be developed for all proposed herbicide treatments as part of the treatment zone prescriptions. Herbicide use will depend on the treatment objective, season, weed species, weed growth stage, topography, expected cost, equipment limitations, and potential environmental impacts. Herbicide application rates will depend on weed species, weed density, non-target vegetation (especially TES species), soil type, management zone, wildlife, and presence of surface waters, wetlands, shallow groundwater or groundwater recharge zones.

Vehicle-mounted sprayers (hand guns, booms) will be used primarily along roadways and in off-road areas which are readily accessible by vehicle. Vehicle use will be restricted where soil or vegetation may be significantly disturbed. Examples of restrictive conditions include moist, compactible soil and steep slopes. Boom applicators will only be used where weeds are sufficiently concentrated. Hand gun application will be used for spot treatment of weeds in vehicle accessible areas. Under both hand gun and boom methods, chemicals will be applied in a manner that gives the best coverage with the least amount of drift.

Hand applications will be made with backpack sprayers and wiper applicators. Backpack sprayers will be used on small or scattered patches in rough terrain or environmentally sensitive areas. Contact systematic herbicides, such as glyphosate, will be used to treat individual plants and for seedbed preparation.

Precautions for use will include at a minimum:

- Herbicide applications will not be conducted when wind velocities exceed 10 mph.
- During application periods, weather conditions and temperature will be measured hourly by applicators.
- Calibration checks will be conducted at the beginning of the spraying season and periodically throughout to ensure that equipment is functioning correctly.
- Label requirements will be followed for all herbicide applications. Further precautions may be determined to be necessary during the pre-treatment reviews.
- All contract herbicide applications will be made by a licensed applicator.

The herbicide program will be evaluated annually as part of the overall weed monitoring and evaluation program.

3.3 WEED MANAGEMENT ZONES

Every small spot on earth is unique but it is difficult to manage each in a unique manner. Fortunately many have properties and treatment needs similar enough to allow grouping into weed management zones. These zones are distinguished according to the presence of surface water, shallow groundwater, drainage to surface water, threatened/endangered/sensitive species, intense human use and other factors. These characteristics help define the weed control methods which can be used. Selected weed control methods are identified for each weed management zone. These weed management zones will be used to map all FWP sites in Region 2. Other management zones may be required to delineate future concerns.

3.31 WATER QUALITY PROTECTION MANAGEMENT ZONE (ZONE 1)

These sites include all open water bodies, wetlands, and areas of shallow groundwater where surface and groundwater contamination potential is high. Also included are buffer zones around water bodies sufficient to prevent contamination by chemical herbicides. Steep slopes, hard surfaces and drainage collection areas which direct runoff into open water area also included in this zone.

Weed control efforts in this management zone will be limited to cultural, mechanical and biological methods. Manual methods such as hand pulling, weed whipping, mowing and grubbing will be coordinated using volunteer and FWP labor.

3.32 SENSITIVE SPECIES MANAGEMENT ZONE (ZONE 2)

These zones have animal or plant populations that may be adversely affected by weed control efforts. Species requiring special consideration include those listed as rare, endangered, threatened or sensitive by the Montana Natural Heritage Program. Other special management zones may be identified by FWP.

Weed control efforts in this management zone will concentrate on cultural and mechanical methods however, biological methods will be considered if no potential adverse impacts are identified. Manual methods such as hand pulling and grubbing will be the major control method. More highly qualified or better trained laborers may be needed where sensitive species are difficult to identify.

3.33 HIGH INTENSITY HUMAN USE MANAGEMENT ZONE (ZONE 3)

These sites include picnic tables, tent sites, play areas, restrooms, interpretive sites and other locations where FWP visitors spend the most time and may come into the closest contact with applied herbicides.

Weed control in this management zone will emphasize chemical methods in the initial effort then mechanical and biological methods for the long term. Manual methods such as hand pulling, weed whipping, mowing and grubbing will be coordinated using volunteer and FWP labor. Biological control efforts will include cooperation in releases of biological agents. Chemical control will be considered on a site by site basis and will include a public notification program including newpaper anouncements and erection of signs at application sites. Chemical applications will be made on low-use days, not to include weekends or holidays. No chemical weed control will be used on sites where volunteer mechanical weed control efforts are successful.

3.34 GENERAL WEED MANAGEMENT ZONE (ZONE 4)

These sites include all areas not identified above including entrance roads, borrow and waste pits, parking lots and other sites.

Weed control efforts in this management zone will emphasize chemical control methods over the short term and mechanical, cultural and biological methods over the long term. Manual methods such as hand pulling, weed whipping, mowing and grubbing will be coordinated using volunteer and FWP labor. Biological control efforts will include cooperation in releases of biological agents. Chemical control will be considered on a site by site basis and will include a notification and signing program. No chemical weed control will be used on sites where volunteer mechanical weed control efforts are successful.

3.4 SITE SPECIFIC TREATMENT PLANS

This plan includes general information concerning site characteristics and weed distribution in FWP Region 2. Existing site information is sufficient to define the range of conditions encountered in Region 2 and to define broad management strategies. The existing weed inventory provides information on the most common weeds and is also sufficient to begin defining management strategies.

Despite current interest in weed management, and existing site and weed information, there is a need for more site specific information before final implementation. Additional site information needs include site-specific maps or sketches as well as soil, slope, drainage, groundwater or other information. Additional weed information includes updates on current conditions, new noxious and other weeds not considered in the 1985 inventory and other factors.

A site specific weed management inventory and plan will be completed for each FWP site before treatment. Appendix F illustrates an example form to be completed for each site. Considerations include weed distribution, potential for water contamination, and other factors.

3.5 SITE TREATMENT PRIORITIES

Budget, equipment and manpower limitations require prioritizing sites for weed control efforts. Weed control efforts will likely not be possible on all sites in all years. FWP sites will be prioritized based upon the following factors:

- Weed species.
- Control objectives.
- Stage of infestation.
- Potential for successful control.
- Acreage of weed infestation.
- Potential for spread on FWP property.
- Potential for spread beyond FWP property.
- Public concern over weeds or weed control efforts.
- Existing local weed management projects.
- Intensity of public use.
- Availability of volunteer labor.
- Budgets.
- Other factors.

3.6 OTHER SUBJECTS OF CONCERN

3.61 THREATENED, ENDANGERED AND SENSITIVE SPECIES CONCERNS

Regional land management agencies and conservation organizations have developed listings for threatened, endangered and sensitive (TES) plant and animal species. Some of these species fall under the criteria of the federal endangered species act. Most have been listed in Montana due to concerns about the relative small size of known populations. The goal of this weed management plan includes the preservation of TES species on FWP sites in Region 2.

Region 2 FWP sites occupy environmental conditions ranging from the aquatic zone and moist forest types to dry forest types and grasslands. Initial evaluations of the potential for TES species are usually based on their known distributions and habitats. These habitat surveys are used as the basis of field inventories to determine if TES species are present. Table 6 illustrates reported occurrences of TES species at or near FWP sites in Region 2 (Montana Natural Heritage Program).

TES species may include both plants and animals. A list of potential species should be compiled based on environmental and site conditions to use as an inventory guide.

TABLE 6. SENSITIVE PLANT OCCURRENCES ON DEPARTMENT FWP ACCESS SITES. All observations include sightings of sensitive plants found within one mile of the listed access sites. An asterisk (*) denotes an occurrence actually on the FWP sites. This information was obtained from the Montana Natural Heritage Program.

River	Site	Species
Clark Fork	Beavertail	Black Cottonwood/Red-Osier Dogwood Community (*Populus trichocarpa/Cornus stolonifera)*
	Council Grove	Pointed Broom Sedge (*Carex scoparia*)*
Bitterroot	Chief Looking Glass	Suksdorf Monkeyflower (*Mimulus suksdorfii*)
	Poker Joe	Pointed Broom Sedge (*Carex scoparia*)
	Bass Creek	Pointed Broom Sedge Shining Flatsedge (*Cyperus rivularis*)
	Painted Rocks	Hollyleaf Clover (*Trifolium gymnocarpon*)
	Wally Crawford	Ponderosa Pine/Bitterbrush Association (*Pinus ponderosa/ Purshia tridentata*)
Blackfoot	Johnsrud Park	Howell's Gum-weed (Grindelia Howellii)
	Clearwater Crossing	Howell's Gum-weed*
	River Junction	Howell's Gum-weed
	Russ Gates FAS	Howell's Gum-weed
	Upsata Lake FAS	Howell's Gum-weed
	Marco Flats	Howell's Gum-weed
	Monture FAS	Howell's Gum-weed* Hall's Rush (*Juncus halli*)*
Clearwater	Harper's Lake	Howell's Gum-weed
	Placid Lake	Howell's Gum-weed
	Salmon Lake	Beck water-marigold (*Bidens beckii*) Howell's Gum-weed
Fish Creek	Forks	Kellogia (*Kellogia galiodes*)

3.62 MONITORING AND RECORD KEEPING

A monitoring program will be used to document the effectiveness of weed management activities. Two to four sites will be selected each year where control efforts are planned. Data on weeds and other values will be collected before weed control treatment and annually for 1 - 2 years to evaluate effectiveness. At a minimum, photo points will be used to document effects. When possible, plots will be established, photographed, measured and re-measured to document target reductions in weed coverage and impacts on non-target species. Appendix G discusses monitoring methods for use in Region 2.

State pesticide use law and regulation requires that the applicator make and retain records of their use of pesticides. The application records must be submitted to the state department of agriculture on at least an annual basis. These records must be made available to state investigative officers at any time following a pesticide use complaint. All aspects of applicator licensing, re-certification training, and record keeping regulations administered by the state government are in-turn supervised by the United States Environmental Protection Agency. FWP will have responsibility for fulfilling these requirements when chemicals are applied by FWP personnel. Contractors will be responsible for filing in respect to contracted services and to provide FWP with copies of all reporting documents.

3.63 CONTRACTED SERVICES

Weed management activities, especially herbicide applications may be contracted when FWP personnel and equipment are not available. Contractors must be licensed and knowledgeable concerning the specific weeds to be treated and chemicals to be used. Contractors should be familiar with all components of this weed management plan especially those regarding safety and emergency response. Contractors must be provided with clear information including maps of zones to be treated.

Contractors must be supervised on a regular basis to insure compliance with contract specifications. Continuous supervision should be exercised in sensitive zones or in relation to expressed public concern.

At a minimum, contractors should keep detailed records concerning applications including the time and date of all applications, chemicals used, amounts, mixing notes (amount of chemical + amount of water), public contacts, weather and other pertinent information. This record-keeping requirement can be coordinated with other pesticide use reporting requirements.

3.64 NOTIFICATION

Public notification regarding weed management activities will be a continuing part of the FWP program. This program will include:

- Annual public notice through press releases to newspaper, radio and television sources concerning weed manage activities. Information may include chemical application schedules as well as other information on weeds and weed control activities such as notice of volunteer weed pulls. If media do not provide this information to the public, FWP will consider paid advertising.

- FWP will post highly visible signs prior to, during and immediately following chemical herbicide applications. Signs shall include the application date, chemical, principal target weeds, FWP contact for further information. Signs will be posted at the property entrance and near areas of concentrated human use.

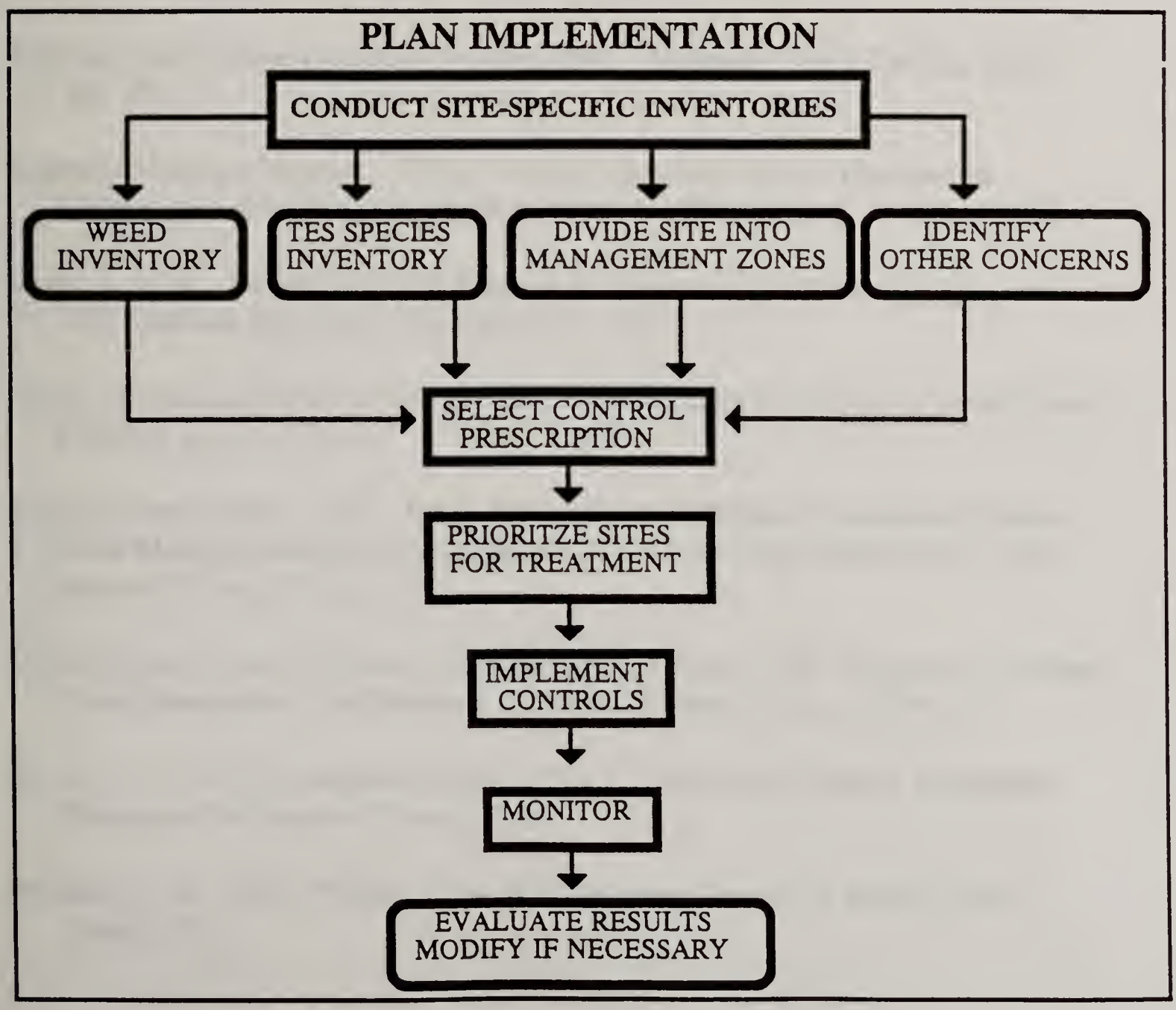
3.65 PESTICIDE SPILL EMERGENCY RESPONSE

Appendix H contains an emergency response plan for pesticide spill incidents. This plan should be carried with all applicators including both FWP and contract personnel. Contract requirements should include discussion of and adherence to these procedures in case of pesticide emergencies.

4.0 SUMMARY

This weed management plan establishes an Integrated Pest Management approach to controlling weeds in FWP Region 2. The plan provides weed control as required by state law and FWP policy while protecting important resources including water quality, aquatic and terrestrial habitat, species diversity and human health.

The progression of events to implementation this plan are as follows.



5.0 REFERENCES

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APPENDICES

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APPENDIX A. LIST OF MONTANA NOXIOUS WEEDS

APPENDIX A. LIST OF MONTANA NOXIOUS WEEDS

Category 1

Canada thistle	Cirsium arvense
Field bindweed	Convolvulus arvensis
Whitetop	Cardia draba
Leafy spurge	Euphorbia esula
Spotted knapweed	Centaurea maculosa
Diffuse knapweed	Centaurea diffusa
Russian knapweed	Centaurea repens
Dalmation toadflax	Linaria dalmatica
St. Johnswort	Hypericum perforatum

Category 1 noxious weeds are weeds that are currently established in many counties of the state. Management criteria for control of these weeds is necessary in all counties to contain or suppress existing infestations or to prevent, through eradication or other appropriate measures, new infestation of these weeds. All of these weeds render land unfit or greatly limit the beneficial uses. (rule 4.5.202)

Category 2

Dyer's Woad	Isatis tinctoria
Purple loosestrife	Lythrum salicaria
Sulphur cinquefoil	Potentilla recta

Category 2 noxious weeds are weeds that have not been detected in the State of Montana or have recently been introduced in the State of Montana. These weeds have the potential for rapid spread and invasion of lands, thereby rendering them unfit for beneficial uses. County planning to prevent the spread of introduction of these weeds is necessary. Management criteria for detection and immediate action to eradicate or contain these weeds is necessary in all counties. (rule 4.5.203)

Category 3

–Yellow starthistle	Centaurea solstitialis
–Common crupinia	Crupinia vulgaris
–Rush skeletonweed	Chondrilla juncea

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APPENDIX B. LAWS AND REGULATIONS RELATED TO WEED CONTROL IN MONTANA

State and federal laws, policies, and programs that will affect FWP Region 2 activities include:

- Creating a VISION for the Future of Montana's Department of Fish, Wildlife & Parks (1992)
- Weed Control Program for Lands Managed by the Montana Department of Fish, Wildlife and Parks (1983)
- Montana Pesticide Control Act (80-8-801 *et seq.*, MCA)
- Montana Weed Control Act (80-7-701 *et seq.*, MCA)
- Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). This law, administered by the Environmental Protection Agency, provides for the registration of pesticides, certification of applicators to apply restricted use pesticides and enforcement of pesticide regulations.
- Montana Noxious Weed Trust Fund Act of 1985 (80-7-801 *et seq.*, MCA) as amended 1991 and Rules
- Montana Water Quality Act (75-5-101 *et seq.*, MCA)
- Montana Agricultural Chemical Ground Water Protection Act of 1989 (80-15-100 *et seq.*, MCA)
- Montana Environmental Policy Act (MEPA, 75-1-101 *et esq.*, MCA)
- Missoula County Noxious Weed Management Plan
- Missoula Water Quality District

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APPENDIX C. BIOLOGICAL WEED CONTROL AGENTS IN MONTANA

HOST	CONTROL AGENT	ACTION
Knapweeds	Agapeta zoegana	root mining moth
	Chaetorellia acrolophi	seed head fly
	Cyphocleonus achates	root weevil
	Larinus minutus	seed head weevil
	Larinus obtusus	seed head beetle
	Metzneria paucipunctella	moth feeds on flowerets and seeds
	Pelochrista medullana	root-mining moth
	Pterolonche inspersa	root moth
	Sclerotinia spp.	fungus
	Sphenoptera jugoslavica	root-mining beetle
	Subanguinia picridis	leaf gall nematode
	Terellia virens	seed head fly
	Urophora affinis U. quadrifasciata	gallfly larvae attacks seed head
Leafy spurge	Aphthona cyparissiae	flea beetle larvae and adults attack
	Aphthona flava	flea beetle larvae and adults
	A. czwalinae	leaves, stems, and roots
	Bayeria spp.	midge causes shoot tip galls
	Hyles euphorbiae	hawk moth larvae defoliates
	Oberea erythrocephala	beetle larvae/adults attack stem root crown
	Spurgia esula	shoot-tip gall midge
St. Johnswort (goatweed)	Chrysolina quadrigemina	beetle defoliator
Musk thistle	Rhinocyllus conicus	weevil attacks the seed head
	Trichosiracalus horridus	weevil attacks rosettes
Canada thistle	Ceuorhynchus litura	stem mining weevil
	Uphora cardui	stem and shoot gallfly
Dalmation toadflax	Calophasia lunula	defoliating larvae/moth

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APPENDIX D. PESTICIDE LABELS AND MATERIAL SAFETY DATA SHEETS (MSDS).

Pesticide labels are an important component of chemical pesticide use and safety. Labels are booklet format documents supplied with each container of product. The label contains detailed information to support four important goals of the regulation process for pesticide use including Identification, Warnings, Special Practices and Legal Requirements. Pesticide labels have the force of law and should be an integral part of a weed management program.

Identification
The active ingredients contents of the product are specified using standardized chemical terms and identification codes. The manufacturer is listed.

Protection Of Health And Environment.
Warnings and safety procedures are detailed for the protection of applicators, the general public, non-target organisms, and the environment. Health and safety warnings must be made using terms with specific meaning as to the degree of potential hazard. Safety procedures to minimize these hazards are listed. When useful for a specific pesticide product these safety procedures include such things as use of protective clothing, time period restrictions for re-entry to a sprayed area, prohibitions against mixtures that would produce adverse reactions. Known potential environmental hazards from the use of the specific product are stated in the label. For example, if the active ingredient has a high potential to be leached down through the soil and contaminate shallow groundwater this hazard is detailed
in a warning statement.

Specific Application Practices
The target organism for which the product is recommended are identified. Application rates and timing are detailed. The geographic areas and types of sites in which the product can be used are stated. Many products can only be used in certain states or counties, while their use may be expressly forbidden in other areas where that product can create an environmental hazard because of climatic or soil conditions.

Legal Requirements To Follow The Label
The label is a legal notification to the applicator. It has the force of law. The label states "It is a violation of Federal Law to use this product in a manner inconsistent with its labeling."

ARSENAL®

herbicide

SPECIMEN

ACTIVE INGREDIENT:

Isopropylamine salt of Imazapyr (2-[4,5-dihydro-4-methyl-4-(1- methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-pyridinecarboxylic acid)*	27.6%
INERT INGREDIENTS	72.4%
TOTAL	100.0%

*Equivalent to 22.6% 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-pyridinecarboxylic acid or 2 pounds acid per gallon.

EPA Reg. No. 241-273

KEEP OUT OF REACH OF CHILDREN

CAUTION!/¡PRECAUCION!

PRECAUCION AL USUARIO: Si usted no lee inglés, no use este producto hasta que la etiqueta le haya sido explicada ampliamente.

In case of emergency endangering life or property involving this product, call collect, day or night, Area Code 201-835-3100.

See inside for Additional Precautionary Statements
See inside for Directions For Use.

CYANAMID

American Cyanamid Company
Agricultural Division
Vegetation and Pest Control
Wayne, NJ 07470

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PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS

CAUTION!

Avoid contact with skin, eyes or clothing. Avoid breathing spray mist. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse.

FIRST AID

IF ON SKIN: Wash with plenty of soap and water.

IF IN EYES: Flush with plenty of water. Get medical attention if irritation persists.

PHYSICAL AND CHEMICAL HAZARDS

Spray solutions of ARSENAL should be mixed, stored and applied only in stainless steel, fiberglass, plastic and plastic-lined steel containers.

DO NOT mix, store or apply ARSENAL or spray solutions of ARSENAL in unlined steel (except stainless steel) containers or spray tanks.

ENVIRONMENTAL HAZARDS

DO NOT apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. DO NOT contaminate water when disposing of equipment washwaters.

IMPORTANT

DO NOT use on food or feed crops. **DO NOT** treat irrigation ditches or water used for crop irrigation or for domestic purposes. Keep from contact with fertilizers, insecticides, fungicides and seeds. **DO NOT** apply or drain or flush equipment on or near desirable trees or other plants, or on areas where their roots may extend, or in locations where the chemical may be washed or moved into contact with their roots. **DO NOT** use on lawns, walks, driveways, tennis courts, or similar areas. **DO NOT** side trim desirable vegetation with this product. Prevent drift of spray to desirable plants. **DO NOT USE** in California.

Clean application equipment after using this product by thoroughly flushing with water.

GENERAL INFORMATION

ARSENAL herbicide is an aqueous solution containing surfactant to be mixed in water and applied as a spray for control of most annual and perennial grasses and broadleaf weeds on noncropland areas.

ARSENAL may be applied either preemergence or postemergence to the weeds; however, postemergence application is the method of choice in most situations, particularly for control of perennials. For maximum activity, weeds should be growing vigorously at the time of postemergence applications. The preemergence activity of ARSENAL will provide residual control of new germination of most weed species following a postemergence application.

ARSENAL is readily absorbed through foliage and roots and is translocated rapidly throughout the plant, with accumulation in the meristematic regions. Treated plants stop growing soon after spray application. Chlorosis appears first in the newest leaves, and necrosis spreads from this point. In perennials, the herbicide is translocated into, and kills, underground storage organs, thus preventing regrowth. Chlorosis and tissue necrosis may not be apparent in some plant species until two weeks after application. Complete kill of plants may not occur for several weeks.

DISCLAIMER

The label instructions for the use of this product reflect the opinion of experts based on field use and tests. The directions are believed to be reliable and should be followed carefully. However, it is impossible to eliminate all risks inherently associated with use of this product. Ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the use or application of the product contrary to label instructions, all of which are beyond the control of American Cyanamid Company. All such risks shall be assumed by the user.

American Cyanamid Company warrants only that the material contained herein conforms to the chemical description on the label and is reasonably fit for the use therein described when used in accordance with the directions for use, subject to the risks referred to above.

Any damages arising from a breach of this warranty shall be limited to direct damages and shall not include consequential commercial damages such as loss of profits or values or any other special or indirect damages.

American Cyanamid Company makes no other express or implied warranty, including other express or implied warranty of FITNESS or of MERCHANTABILITY.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

ARSENAL herbicide should be used only in accordance with recommendations on the leaflet label attached to the container. Keep containers closed to avoid spills and contamination.

A postemergence use of ARSENAL is recommended for control of most annual and perennial grasses and broadleaf weeds on noncropland areas such as railroad, utility, pipeline and highway rights-of-way, utility plant sites, petroleum tank farms, pumping installations, fence rows, storage areas, non-irrigation ditchbanks, and other similar areas. ARSENAL is recommended for the establishment and maintenance of wildlife openings. ARSENAL may also be used for the release of unimproved bermudagrass (see specific labeling).

STORAGE AND DISPOSAL

PROHIBITIONS: DO NOT store below 10°F. DO NOT contaminate water, food or feed by storage or disposal.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER DISPOSAL: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in an approved sanitary landfill, or by incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

APPLICATION EQUIPMENT AND TECHNIQUES

ARSENAL herbicide may be applied with the following application equipment:

Aerial: fixed wing and helicopter.

Boom: conventional boom mounted, manifold mounted, and off-center nozzles.

Low-volume hand-held spray equipment: backpack, knapsack and other pump-up type pressure sprayers and backpack mist blowers used to direct application to weed foliage.

High-volume spray equipment: high pressure handguns and vehicle mounted high-volume directed spray equipment.

AERIAL EQUIPMENT

Uniformly apply the recommended amount of ARSENAL with properly calibrated aerial equipment in 5 to 30 gallons of water per acre. All precautions should be taken to minimize or eliminate spray drift. Aerial equipment designed to minimize spray drift, such as a helicopter equipped with a MICROFOIL boom, THRU-VALVE boom or raindrop nozzles, must be used. Applications should not be made under gusty conditions or when wind velocity exceeds 5 mph. Except when applying with a MICROFOIL boom, a drift control agent may be added at the recommended label rate. A foam reducing agent may be added at the recommended label rate, if needed.

IMPORTANT: DO NOT make applications by fixed wing aircraft unless appropriate buffer zones can be maintained to insure that drift does not occur off the target area. Thoroughly clean application equipment, including landing gear, immediately after use. Prolonged exposure of this product to uncoated steel (except stainless steel) surfaces may result in corrosion and failure of the exposed part.

BOOM EQUIPMENT

Mix the recommended amount of ARSENAL in 10 to 60 gallons of water per acre in the spray tank with the agitator running. A foam reducing agent may be added at the recommended label rate, if needed. If desired, a spray pattern indicator may be added at the recommended label rate. Check for even distribution in spray pattern.

IMPORTANT: To minimize drift, select proper nozzles; to avoid spraying a fine mist, DO NOT exceed spray pressure of 50 psi, and DO NOT spray under windy or gusty conditions.

Clean application equipment after using this product by thoroughly flushing with water.

LOW-VOLUME HAND-HELD SPRAY EQUIPMENT

Thoroughly mix a 1/2 to 1 percent solution of ARSENAL in water. To determine the proper percent solution of ARSENAL to use, see the "WEEDS CONTROLLED" section of this label and the "PERCENT SOLUTION RATE GUIDE" below. The table calculations below are based on an approximate delivery volume of 50 to 75 gallons per acre.

PERCENT SOLUTION RATE GUIDE

ARSENAL RATE PER ACRE	PERCENT SOLUTION TO MIX
2-3 pints	1/2%
3-4 pints	3/4%
4-6 pints	1%

For best results, uniformly cover the foliage of the vegetation to be controlled with the spray solution.

DO NOT overapply and cause runoff from the treated foliage.

To mix the spray solution, add the volume of ARSENAL indicated in the table below to the desired amount of water.

SPRAY SOLUTION MIXING GUIDE

SOLUTION VOLUME	AMOUNT OF ARSENAL TO USE (fluid volume)		
	1/2%	3/4%	1%
1 gallon	2/3 oz.	1 oz.	1-1/3 oz.
5 gallons	3-1/3 oz.	5 oz.	6-1/2 oz.
10 gallons	6-2/3 oz.	10 oz.	13 oz.
25 gallons	1 pint	1-1/2 pints	2 pints

2 tablespoons = 1 fluid ounce

IMPORTANT: DO NOT exceed recommended dosage rate per acre. DO NOT side-trim desirable vegetation with this product. Clean application equipment after using this product by thoroughly flushing with water.

HIGH-VOLUME SPRAY EQUIPMENT

ARSENAL may be applied using high-volume spray equipment. For best results, apply ARSENAL using the least amount of water practical to obtain uniform coverage of the vegetation foliage. Using excessive spray volumes which cause runoff from the plant foliage may result in reduced performance.

When using spray volumes greater than 60 gallons per acre, additional nonionic surfactant such as Ortho* X-77 must then be added at the rate of 1 quart per 100 gallons of spray solution to provide optimum wetting and/or contact activity. A foam reducing agent may be added at the recommended label rate, if needed. If desired, a spray pattern indicator may be added at the recommended label rate.

To mix the spray solution, determine the proper ARSENAL pints per acre rate from the "WEEDS CONTROLLED" section of this label and mix according to the table below.

SPRAY SOLUTION MIXING GUIDE

SPRAY VOLUME (GAL/ACRE)	PINTS ARSENAL TO MIX PER 100 GALLONS WATER			
	3 PTS/ACRE	4 PTS/ACRE	5 PTS/ACRE	6 PTS/ACRE
50	6	8	10	12
100	3	4	5	6
150	2	2-3/4	3-1/4	4

IMPORTANT: DO NOT exceed recommended dosage rate per acre. DO NOT side-trim desirable vegetation with this product. Clean application equipment after using this product by thoroughly flushing with water.

*Registered Trademark of Chevron Chemical Company

FOR CONTROL OF UNDESIRABLE WEEDS IN UNIMPROVED BERMUDAGRASS AND BAHIAGRASS

For use on unimproved bermudagrass and bahiagrass turf such as roadsides, utility rights-of-way and other noncropland industrial sites. The application of ARSENAL on established common and coastal bermudagrass and bahiagrass provides control of labeled broadleaf and grass weeds. Competition from these weeds is eliminated, releasing the bermudagrass and bahiagrass. Treatment of bermudagrass with ARSENAL results in a compacted growth habit and seedhead inhibition.

Uniformly apply with properly calibrated ground equipment using at least 10 gallons of water per acre with a spray pressure 20 to 50 psi.

DOSAGE RATES AND TIMING

EARLY SPRING - DORMANT: Apply ARSENAL at 6 to 12 fluid oz. per acre for bermudagrass, and 4 to 8 fluid oz. per acre for bahiagrass when the grass is still dormant and has not initiated new growth.

SPRING - UP TO 25% GREEN-UP: Apply ARSENAL at 6 to 8 fluid oz. per acre for bermudagrass and 4 to 8 fluid oz. per acre for bahiagrass after the grass has initiated green-up but has not exceeded 25% green-up.

WEEDS CONTROLLED

Bedstraw *(Galium* spp.*)*
Bishopweed *(Ptilimnium capillaceum)*
Buttercups *(Ranunculus* spp.*)*
Carolina geranium *(Geranium carolinianum)*
Fescue *(Festuca* spp.*)*
Foxtail *(Setaria* spp.*)*
Little barley *(Hordeum pusillum)*
Seedling Johnsongrass *(Sorghum halepense)*
Wild carrot *(Daucus carota)*
White clover *(Trifolium repens)*
Yellow woodsorrel *(Oxalis stricta)*

1. DO NOT APPLY to grass during its first growing season.
2. DO NOT APPLY to grass that is under stress from drought, disease, insects, or other causes.
3. Temporary yellowing of grass may occur when treatment is made after growth commences.
4. DO NOT add a surfactant.

FOR CONTROL OF UNDESIRABLE WEEDS UNDER PAVED SURFACES

ARSENAL herbicide can be used under asphalt, pond liners and other paved areas, ONLY in industrial sites or where the pavement has a suitable barrier along the permimeter that prevents encroachment of roots of desirable plants.

ARSENAL should be used only where the area to be treated has been prepared according to good construction practices. If rhizomes, stolons, tubers or other vegetative plant parts are present in the site, they should be removed by scalping with a grader blade to a depth sufficient to insure their complete removal.

APPLICATION DIRECTIONS

Applications should be made to the soil surface only when final grade is established. Do not move soil following ARSENAL application.

Uniformly apply ARSENAL to the area to be surfaced, including the shoulder areas at a rate of 6 pints per acre.

Apply ARSENAL in sufficient water (at least 100 gal. per acre) to insure thorough wetting of the soil surface. Add the recommended amount of ARSENAL to clean water in the spray tank during the filling operation. Agitate before spraying.

For Herbicide Activation:

On Moist Subsoils: Apply ARSENAL after final grading and immediately before laying asphalt or liner surface. Apply uniformly, using at least 100 gallons of water per acre.

If Moisture Is Not Present: Incorporation of ARSENAL is needed for herbicide activation. ARSENAL can be incorporated into the soil to a depth of 4 to 6 inches using a rototiller or disc. Rainfall or irrigation of 1 inch will also provide uniform incorporation. Do not allow treated soil to wash or move into untreated areas.

IMPORTANT

Paving should follow ARSENAL applications as soon as possible. DO NOT apply where the chemical may contact the roots of desirable trees or other plants.

The product is not recommended for use under pavement on residential properties such as driveways or parking lots, nor is it recommended for use in recreational areas such as under bike or jogging paths, golf cart paths, or tennis courts, or where landscape plantings could be anticipated.

Injury or death of desirable plants may result if this product is applied where roots are present or where they may extend into the treated area. Roots of trees and shrubs may extend a considerable distance beyond the branch extremities or drip line.

WEEDS CONTROLLED

ARSENAL herbicide will provide postemergence control with residual control of the following target vegetation species at the rates listed. Residual control refers to control of newly germinating seedlings in both annuals and perennials. In general, annual weeds may be controlled by postemergence or preemergence applications of ARSENAL; whereas, for established biennials and perennials postemergence applications of ARSENAL are recommended. ARSENAL herbicide should be used only in accordance with the recommendations on this label and the leaflet label.

GRASSES

COMMON NAME	SPECIES	GROWTH HABIT[2]
Apply 2-3 pints per acre[1]		
Annual bluegrass	*(Poa annua)*	A
Broadleaf signalgrass	*(Brachiaria platphylla)*	A
Canada bluegrass	*(Poa compressa)*	P
Downy brome	*(Bromus tectorum)*	A
Fescue	*(Festuca* spp.*)*	A/P
Foxtail	*(Setaria* spp.*)*	A
Italian ryegrass	*(Lolium multiflorum)*	A
Johnsongrass	*(Sorghum halepense)*	P
Kentucky bluegrass	*(Poa pratensis)*	P
Lovegrass	*(Eragrostis* spp.*)*	A/P
Orchardgrass	*(Dactylis glomerata)*	P
Paragrass	*(Brachiaria mutica)*	P
Quackgrass	*(Agropyron repens)*	P
Sandbur	*(Cenchrus* spp.*)*	A
Sand dropseed	*(Sporobolus cryptandrus)*	P
Smooth brome	*(Bromus inermis)*	P
Vaseygrass	*(Paspalum urvillei)*	P
Wild oats	*(Avena fatua)*	A
Witchgrass	*(Panicum capillare)*	A
Apply 3-4 pints per acre[1]		
Beardgrass	*(Andropogon* spp.*)*	P
Cheat	*(Bromus secalinus)*	A
Crabgrass	*(Digitaria* spp.*)*	A
Fall panicum	*(Panicum dichotomiflorum)*	A
Goosegrass	*(Eleusine indica)*	A
Prairie threeawn	*(Aristida oligantha)*	P
Reed canarygrass	*(Phalaris arundinacea)*	P

GRASSES

COMMON NAME	SPECIES	GROWTH HABIT[2]
Apply 3-4 pints per acre[1]		
Torpedograss	*(Panicum repens)*	P
Wild barley	*(Hordeum* spp.*)*	A
Apply 4-6 pints per acre[1]		
Bahiagrass	*(Paspalum notatum)*	P
Bermudagrass	*(Cynodon dactylon)*	P
Big bluestem	*(Andropogon gerardi)*	P
Cattail	*(Typha* spp.*)*	P
Cogongrass	*(Imperata cylindrica)*	P
Dallisgrass	*(Paspalum dilatatum)*	P
Feathertop	*(Pennisetum villosum)*	P
Guineagrass	*(Panicum maximum)*	P
Phragmites	*(Phragmites australis)*	P
Prairie cordgrass	*(Spartina pectinata)*	P
Saltgrass	*(Distichlis stricta)*	P
Timothy	*(Phleum pratense)*	P
Wirestem muhly	*(Muhlenbergia frondosa)*	P

BROADLEAF WEEDS

COMMON NAME	SPECIES	GROWTH HABIT[2]
Apply 2-3 pints per acre[1]		
Burdock	*(Arctium* spp.*)*	B
Camphorweed	*(Heterotheca subaxillaris)*	P
Carpetweed	*(Mollugo verticillata)*	A
Carolina geranium	*(Geranium carolinianum)*	A
Clover	*(Trifolium* spp.*)*	A/P
Common chickweed	*(Stellaria media)*	A
Common ragweed	*(Ambrosia artemisiifolia)*	A
Dandelion	*(Taraxacum officinale)*	P
Dogfennel	*(Eupatorium capillifolium)*	A
Filaree	*(Erodium* spp.*)*	A
Fleabane	*(Erigeron* spp.*)*	A
Hoary vervain	*(Verbena stricta)*	P
Horseweed	*(Conyza canadensis)*	A
Indian mustard	*(Brassica juncea)*	A
Lambsquarters	*(Chenopodium album)*	A
Lespedeza	*(Lespedeza* spp.*)*	P
Miners lettuce	*(Montia perfoliata)*	A
Mullein	*(Verbascum* spp.*)*	B
Nettleleaf goosefoot	*(Chenopodium murale)*	A
Oxeye daisy	*(Chrysanthemum leucanthemum)*	P
Pepperweed	*(Lepidium* spp.*)*	A
Pigweed	*(Amaranthus* spp.*)*	A

BROADLEAF WEEDS

COMMON NAME	SPECIES	GROWTH HABIT[2]
Apply 2-3 pints per acre[1]		
Plantain	*(Plantago* spp.*)*	P
Punctureviné	*(Tribulus terrestris)*	A
Russian thistle	*(Salsola kali)*	A
Smartweed	*(Polygonum* spp.*)*	A/P
Sorrell	*(Rumex* spp.*)*	P
Sunflower	*(Helianthus* spp.*)*	A
Sweet clover	*(Melilotus* spp.*)*	A/B
Tansymustard	*(Descurainia pinnata)*	A
Western ragweed	*(Ambrosia psilostachya)*	P
Wild carrot	*(Daucus carota)*	B
Wild lettuce	*(Lactuca* spp.*)*	A/B
Wild parsnip	*(Pastinaca sativa)*	B
Wild turnip	*(Brassica campestris)*	B
Woollyleaf bursage	*(Ambrosia grayi)*	P
Yellow woodsorrel	*(Oxalis stricta)*	P
Apply 3-4 pints per acre[1]		
Broom snakeweed [3]	*(Gutierrezia sarothrae)*	P
Bull thistle	*(Cirsium vulgare)*	B
Cocklebur	*(Xanthium strumarium)*	A
Desert camelthorn	*(Alhagi camelorum)*	P
Diffuse knapweed	*(Centaurea diffusa)*	A
Dock	*(Rumex* spp.*)*	P
Goldenrod	*(Solidago* spp.*)*	P
Pokeweed	*(Phytolacca americana)*	A
Purple loosestrife [3]	*(Lythrum salicaria)*	P
Purslane	*(Portulaca* spp.*)*	A
Rush skeletonweed [3]	*(Chondrilla juncea)*	B
Saltbush	*(Atriplex* spp.*)*	A
Stinging nettle [3]	*(Urtica dioica)*	P
Yellow starthistle	*(Centaurea solstitialis)*	A
Apply 4-6 pints per acre[1]		
Arrowwood	*(Pluchea sericea)*	A
Canada thistle	*(Cirsium arvense)*	P
Giant ragweed	*(Ambrosia trifida)*	A
Japanese bamboo	*(Polygonum cuspidatum)*	P
Little mallow	*(Malva parviflora)*	B
Milkweed	*(Asclepias* spp.*)*	P
Primrose	*(Oenothera kunthiana)*	P
Russian knapweed	*(Centaurea repens)*	P
Silverleaf nightshade	*(Solanum elaeagnifolium)*	P
Sowthistle	*(Sonchus* spp.*)*	A
Texas thistle	*(Cirsium texanum)*	P

VINES AND BRAMBLES

COMMON NAME	SPECIES	GROWTH HABIT[2]
Apply 1 pint per acre		
Field bindweed	*(Convolvulus arvensis)*	P
Hedge bindweed	*(Calystegia sequium)*	A
Apply 2-3 pints per acre[1]		
Wild buckwheat	*(Polygonum convolvulus)*	P
Apply 3-4 pints per acre[1]		
Greenbriar	*(Smilax* spp.*)*	P
Honeysuckle	*(Lonicera* spp.*)*	P
Morningglory	*(Ipomoea* spp.*)*	A/P
Poison ivy	*(Rhus radicans)*	P
Redvine	*(Brunnichia cirrhosa)*	P
Wild rose Including: Multiflora rose Macartney rose	*(Rosa* spp.*)* *(Rosa multiflora)* *(Rosa bractreata)*	P
Apply 4-6 pints per acre[1]		
Blackberry [4]	*(Rubus* spp.*)*	P
Dewberry [4]	*(Rubus* spp.*)*	P
Kudzu [5]	*(Pueraria lobata)*	P
Trumpetcreeper	*(Campsis radicans)*	P
Virginia creeper	*(Parthenocissus quinquefolia)*	P
Wild grape	*(Vitis* spp.*)*	P

BRUSH SPECIES

COMMON NAME	SPECIES	GROWTH HABIT[2]
Apply 4-6 pints per acre[1]		
American beech	*(Fagus grandifolia)*	P
Ash	*(Fraxinus* spp.*)*	P
Bald cypress	*(Taxodium distichum)*	P
Bigleaf maple	*(Acer macrophylum)*	P
Blackgum	*(Nyssa sylvatica)*	P
Boxelder	*(Acer negundo)*	P
Cherry	*(Prunus* spp.*)*	P
Chinaberry	*(Melia azedarach)*	P
Chinese tallow-tree	*(Sapium sebiferum)*	P
Dogwood	*(Cornus* spp.*)*	P
Hawthorn	*(Crataegus* spp.*)*	P
Hickory	*(Carya* spp.*)*	P
Maple	*(Acer* spp.*)*	P
Mulberry	*(Morus* spp.*)*	P
Oak	*(Quercus* spp.*)*	P
Persimmon	*(Diospyros virginiana)*	P
Poplar	*(Populus* spp.*)*	P
Privet	*(Ligustrum vulgare)*	P

BRUSH SPECIES

COMMON NAME	SPECIES	GROWTH HABIT[2]
Apply 4-6 pints per acre[1]		
Russian olive	*(Elaeagnus angustifolia)*	P
Red alder	*(Alnus rubra)*	P
Red maple	*(Acer rubrum)*	P
Rubber rabbitbrush	*(Chrysothamnus nauseosus)*	P
Saltcedar	*(Tamarix ramosissima)*	P
Sassafras	*(Sassafras albidum)*	P
Sourwood	*(Oxydendrum arboreum)*	P
Sumac	*(Rhus* spp.*)*	P
Sweetgum	*(Liquidambar styraciflua)*	P
Willow	*(Salix* spp.*)*	P
Yellow poplar	*(Liriodendron tulipifera)*	P

[1]The higher rates should be used where heavy or well established infestations occur.
[2]Growth Habit - A = Annual, B = Biennial, P = Perennial
[3]For best results early postemergence applications are required.
[4]The degree of control is species dependent. Some *Rubus* species may not be completely controlled.
[5]Use a minimum of 75 GPA - Control of established stands may require repeat applications.

CYANAMID
American Cyanamid Company
Agricultural Division
Vegetation and Pest Control
Wayne, NJ 07470
©1991

PE-11004 11/91

AMERICAN CYANAMID CO.
WAYNE, NJ 07470

MATERIAL SAFETY DATA SHEET

MSDS NO. AG09107-1
CAS NO. Mixture

DATE: OCT 05, 1992

EMERGENCY TELEPHONE: (201)-835-3100 (U.S.A.)

PRODUCT IDENTIFICATION

TRADE NAME:	ARSENAL® NS Herbicide
SYNONYMS:	Imazapyr, isopropylamine salt. 2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl)nicotinic acid, salt with isopropylamine (1:1) 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyri-dinecarboxylic acid, salt with 2-propanamine (1:1); AC252,925; CL252,925
CHEMICAL FAMILY:	Imidazolinone
MOLECULAR FORMULA:	$C_{13}H_{15}N_3O_3.C_3H_9N$
MOLECULAR WEIGHT:	320.400
USAGE:	Herbicide

WARNING STATEMENTS

CAUTION! Keep out of reach of children.
Avoid contact with eyes, skin, or clothing.
Avoid breathing spray mist.

INGREDIENTS

COMPONENT	CAS. NO.	%	PEL/TLV
Inerts		71.90	None Established
Isopropylamine Salt of Imazapyr	081510-83-0	28.10	None Established

REFERENCE:		
	Inerts	None
	Isopropylamine Salt of Imazapyr	None

PHYSICAL PROPERTIES

APPEARANCE AND ODOR:	Clear blue liquid; slight ammonium odor.
BOILING POINT:	Not available
MELTING POINT:	Not applicable
VAPOR PRESSURE:	Not available
SPECIFIC GRAVITY:	1.04 - 1.07
VAPOR DENSITY:	Not available
% VOLATILITY (BY VOL.):	71
OCTANOL / H_2O PARTITION COEF.:	1.3 for the active ingredient at 22°C
PH:	6.6 - 7.2

(cont from pg. 1)

SATURATION IN AIR (BY VOL.):	Not available
EVAPORATION RATE:	Not available
SOLUBILITY IN WATER:	Soluble

FIRE AND EXPLOSION HAZARD INFORMATION

FLASH POINT:	> 98.9°C (210°F) - SETA Closed Cup
FLAMMABLE LIMITS (% BY VOL.):	Not applicable
AUTOIGNITION TEMP:	> 93°C (200°F)
DECOMPOSITION TEMP:	Not available

FIRE EXTINGUISHING MEDIA:
Use water, alcohol foam, dry chemical or carbon dioxide to extinguish fires.

FIRE CONTROL TACTICS:
Wear self-contained, positive pressure breathing apparatus and full fire fighting protective clothing.

Keep unnecessary people away. Use as little water as possible. Dike area of fire to prevent pesticide run-off. Use spray or fog - solid stream may cause spreading.

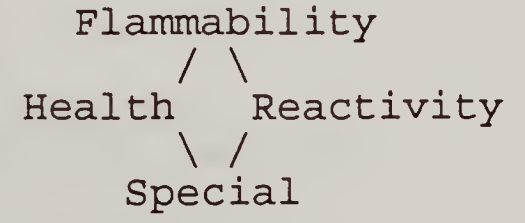
Do not decontaminate personnel or equipment, or handle broken packages or containers without protective equipment as specified in the Exposure Control Section. Decontaminate emergency personnel with soap and water before leaving the fire area.

Avoid breathing dusts, vapors and fumes from burning materials. Control run-off water - if water enters a drainage system, advise the authorities downstream.

NFPA HAZARD RATING

(As Recommended by American Cyanamid Co.)

0 Least
1 Slight
2 Moderate
3 High
4 Severe



REACTIVITY DATA

STABILITY:	Stable
POLYMERIZATION:	Will not occur
INCOMPATIBLE MATERIALS:	Strong oxidizing and reducing agents. Corrosive to mild steel and brass.
HAZARDOUS DECOMPOSITION PRODUCTS:	Combustion may produce oxides of carbon and nitrogen.

HEALTH HAZARD INFORMATION

TOXICITY DATA AND EFFECTS OF OVEREXPOSURE:

(cont from pg. 2) ACUTE TOXICITY DATA:
Toxicological data on this particular formulation is not available. How-ever, data from a similar formulation product have shown the following;

The acute oral LD_{50} for both male and female albino rats is greater than 5000 mg/kg indicating that this material is no more than slightly toxic if ingested.

The acute dermal LD_{50} for both male and female albino rabbits is greater than 2148 mg/kg indicating that this material is no more than slightly toxic by single skin applications.

This formulation may be irritating to the rabbit eye and mildly irritating to the rabbit skin.

CHRONIC TOXICITY DATA:
Mutagenicity: No mutagenic activity was observed in ARSENAL Technical (Imazapyr) by all test methods used. These included unscheduled DNA Synthesis Rat Hepatocyte Assay, in vitro Chinese Hamster Ovary (CHO)/Hypoxanthine Guanine Phoshporiboxyl Transferase (HGPRT) Mutation Assay, Bacterial/Microsome Reverse Mutation (Ames) Test and in vitro Chromosomal Aberrations in Chinese Hamster Ovary Cells.

Teratogenicity: No teratogenic or fetotoxic effects were found at all dose levels tested in mice and rats.

Imazapyr is not listed as a human carcinogen by the IARC, OSHA or NTP.

Isopropylamine salt present in this formulation is not listed as a human carcinogen by the IARC, OSHA or NTP.

EMERGENCY AND FIRST AID PROCEDURES:

IF ON SKIN: Wash skin with plenty of soap and water. Get medical attention if irritation persists.

IF IN EYES: Flush eyes with plenty of water. Get medical attention if irritation persists.

IF SWALLOWED: Drink two glasses of water, induce vomiting if the person is conscious. Obtain medical attention promptly.

IF INHALED: Remove subject to fresh air.

NOTES TO PHYSICIAN:
There is no specific antidote. Treatment of overexposure should be directed at the control of symptoms and the clinical condition.

(cont from pg. 3) MEDICAL CONDITION AGGRAVATED BY OVEREXPOSURE:
A knowledge of the available toxicology information and of the physical and chemical properties of the material suggests that overexposure is unlikely to aggravate existing medical conditions.

EXPOSURE CONTROL METHODS

During formulation of this product, use the following recommended industrial hygiene practices:

Wear chemical splash goggles to prevent contact with the skin. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse.

For end-users, refer to product label for personal protective clothing/equipment if required.

SPILL OR LEAK PROCEDURES

Absorb with an inert material such as clay or sawdust. Place in a closed container for disposal.

WASTE DISPOSAL: Dispose in accord with local, state, and federal regulations. Imazapyr is not a RCRA hazardous waste.

SPECIAL PRECAUTIONS

HANDLING AND STORAGE:
Do not contaminate water, food, or feed by storage or disposal. Store in a secure, dry, well-ventilated, separate room, building or covered area.

Not for use or storage in or around the home.

Keep away from sources of ignition and protect from exposure to fire and heat.

Segregate from oxidizers and incompatible materials listed in the Reactivity Data Section.

ADDITIONAL REGULATORY INFORMATION

SARA Title III Data

Section 311 and 312 Hazard Categories

Immediate Health Hazard	- Y	Reactive Hazard	- N
Delayed Health Hazard	- N	Sudden Pressure Release Hazard	- N
Fire Hazard	- N		

Section 302 Extremely Hazardous Substances - None

Section 313 Toxic Chemicals - None

CERCLA Reportable Quantity

None

APPENDIX

The information and statements herein are believed to be reliable but are not to be construed as a warranty or representation for which we assume legal responsibility. Users should undertake sufficient verification and testing to determine the suitability for their own particular purpose of any information or products referred to herein. NO WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE IS MADE.

SOURCE AND DATE INFORMATION	SHEET NO.:	AG09107-1
	DATE:	OCT 05, 1992

Specimen Label

DowElanco

Stinger*

Herbicide

For selective postemergence control of broadleaf weeds in sugar beets, field corn, wheat, barley, and oats not underseeded with a legume, Christmas tree plantations, grasses grown for seed, fallow cropland, rangeland and permanent grass pastures, non-cropland areas, conservation reserve program (CRP) acres

Active Ingredient:
clopyralid: 3,6-dichloro-2-pyridinecarboxylic acid, monoethanolamine salt 40.9%
Inert Ingredients.....59.1%
TOTAL.....100.0%
Acid Equivalent:
clopyralid: 3,6-dichloro-2-pyridinecarboxylic acid - 31% – 3 lb/gal
EPA Reg. No. 62719-73
EPA Est. 464-MI-1
Net Contents 1 qt

Precautionary Statements

KEEP OUT OF REACH OF CHILDREN

CAUTION

PRECAUSCION:

PRECAUSCION AL USUARIO:
Si usted no lee ingles, no use este producto hasta que la etiqueta le haya sido explicada ampliaments.

Hazards to Humans and Domestic Animals

Causes Eye Injury • Harmful If Inhaled Or Absorbed Through Skin. Avoid contact with eyes, skin or clothing. Avoid breathing spray mist. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse.

First Aid

If in eyes: Flush with plenty of water. Get medical attention if irritation persists.
If on skin: Wash with plenty of soap and water. Get medical attention.

Environmental Hazards

Do not contaminate water when disposing of equipment washwaters. Do not contaminate water used for irrigation or domestic purposes. Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark.

Clopyralid is a chemical which can travel (seep or leach) through soil and under certain conditions contaminate ground- water which may be used for irrigation or drinking purposes. Users are advised not to apply clopyralid where soils have a rapid to very rapid permeability throughout the profile (such as loamy sand to sand) and the water table of an underlying aquifer is shallow, or to soils containing sinkholes over limestone bedrock, severely fractured surfaces, and substrates which would allow direct introduction into an aquifer. Your local agricultural agencies can provide further information on the type of soil in your area and the location of groundwater.

Physical or Chemical Hazards

Combustible - Do not use or store near heat or open flame. Do not cut or weld container.

Notice: Read the entire label. Use only according to label directions.

Before buying or using this product, read Warranty Disclaimer and Limitation of Remedies sections elsewhere on this label.
In case of an emergency endangering life or property involving this product, call collect 517-636-4400
Agricultural Chemical: Do Not Ship or Store with Food, Feeds, Drugs, or Clothing

Stinger*

Do not use in a greenhouse. Excessive amounts of this herbicide in the soil may temporarily inhibit seed germination or plant growth.

Broadleaf Weeds Controlled

artichoke, Jerusalem
buckwheat, wild
buffalobur†
burdock, common
chamomile, false (scentless)
chamomile, mayweed (dogfennel)
clover, sweet
clover, red
cocklebur, common
coffeeweed
cornflower (bachelor button)
dandelion
dock, curly
groundsel, common
hawksbeard, narrowleaf
horseweed
jimsonweed
knapweed, diffuse
knapweed, Russian†
knapweed, spotted
ladysthumb†
lettuce, prickly
locoweed, white
locoweed, Lambert
marshelder
nightshade, Eastern black
nightshade, cutleaf
nightshade, hairy
oxeye daisy
pineappleweed
ragweed, common
ragweed, giant
salsify, meadow (goatsbeard)
sicklepod
smartweed, green†
sorrel, red
sowthistle, annual
sowthistle, perennial†
starthistle, yellow
sunflower
thistle, Canada
thistle, musk
vetch
volunteer alfalfa
volunteer beans
volunteer lentils
volunteer peas

†These weeds may only be suppressed. Suppression is a visual reduction in weed competition (reduced population or vigor) as compared to untreated areas. The degree of weed control and duration of effect will vary with weed size and density, spray rate and coverage, and growing conditions before, during, and after the time of treatment. For perennial weeds, Stinger will control the initial top growth and inhibit regrowth during the season of application (season-long control). At higher use rates shown on this label, Stinger may cause a reduction in shoot regrowth in the season following application; however, plant response may be inconsistent due to inherent variability in shoot regrowth from perennial root systems.

Weed Control Guidelines† Amount of Stinger Per Acre x Use Site††

Weed Species	Growth Stage,	Sugar Beet, Christmas Trees	Wheat, Barley, Oats	Grasses for Seed	Fallow Cropland	Range & Pasture, CRP, & Non-crop	Field Corn
clover cocklebur sunflower ragweeds Jerusalem artichoke jimsonweed volunteer soybean vetch marshelder	Up to 5 leaf	1/4-1/2 pt	1/4-1/3 pt	1/4-1/2 pt	1/4-1/2 pt	1/3-2/3 pt	1/4-1/2 pt
wild buckwheat nightshade sp. buffalobur smartweeds (suppression)	1-3 leaf stage, but before vining 2-4 leaf 2-3 leaf	1/2 pt					
Canada thistle sowthistle (suppression)	rosette to prebud	1/2 -2/3 pt	1/4-1/3 pt	1/3-2/3 pt	2/3 pt	2/3-1 pt	1/3-2/3 pt
knapweeds, spotted/difuse	up to bud stage	2/3 pt	---	2/3 pt	—	2/3-1pt	—
knapweeds, Russian (suppression)						1- 1 1/3 pt	----

† This table is intended as a reference only. For complete instructions see the body of the text.
†† Use the lower rate for light to moderate infestations and good growing conditions and the higher rate for dense infestations or under poor growing conditions such as drought.

For measuring small volumes, refer to the following table to obtain appropriate conversions of pints to fluid ounces.

Conversion Chart - Pints to Fluid Ounces

Pints	Fluid Ounces
1/3	5
1/4	4
1/2	8
2/3	11

MATERIAL SAFETY DATA SHEET

DOWELANCO INDIANAPOLIS, IN 46268 EMERGENCY (517) • 636 • 4400

Product Code: 08505 Page: 1

Product Name: STINGER (R) HERBICIDE

Effective Date: 08/04/92 Date Printed: 02/11/93 MSDS:002805

1. INGREDIENTS: (% w/w, unless otherwise noted)

Active Ingredient:		40.9%
Clopyralid (3,6-dichloro-2-pyridinecarboxylic acid), Monoethanolamine salt	CAS# 057754-85-5	
Inert Ingredients:		59.1%
Water	CAS# 007732-18-5	
Isopropyl alcohol	CAS# 000067-63-0	
Proprietary surfactant		

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200). In addition, other substances not 'Hazardous' per this OSHA Standard may be listed. Where proprietary ingredient shows, the identity may be made available as provided in this standard.

2. PHYSICAL DATA:

BOILING POINT: 212F, 100C
VAP. PRESS: 23.5 mmHg @ 20C
VAP. DENSITY: 1.06 @ 20C
SOL. IN WATER: Infinite
SP. GRAVITY: 1.161 @ 68F, 20C
APPEARANCE: Dark brown clear liquid
ODOR: Sweet

3. FIRE AND EXPLOSION HAZARD DATA:

FLASH POINT: 117F, 47.2C
METHOD USED: TCC

FLAMMABLE LIMITS
LFL: Not deter.

(Continued On Page 2)
(R) Indicates a Trademark of DowElanco

5. ENVIRONMENTAL AND DISPOSAL INFORMATION:

ACTION TO TAKE FOR SPILLS/LEAKS: Absorb spills with inert materials such as sawdust or sand. Dike areas in case of large spills. Do not contaminate water supplies and irrigation ditches.

DISPOSAL METHOD: Bury waste material in approved dump (non-crop land) away from water supplies in accordance with applicable federal, state, and local regulations.

6. HEALTH HAZARD DATA:

EYE: May cause very slight transient (temporary) corneal injury.

SKIN CONTACT: Prolonged exposure may cause skin irritation. Repeated contact may cause drying or flaking of skin.

SKIN ABSORPTION: A single prolonged exposure is not likely to result in the material being absorbed through skin in harmful amounts. The LD50 for skin absorption in rabbits is >5000 mg/kg.

INGESTION: Single dose oral toxicity is low. The oral LD50 for both male and female rats is >5000 mg/kg. Small amounts swallowed incidental to normal handling operations are not likely to cause injury; swallowing amounts larger than that may cause injury.

INHALATION: Excessive vapor concentrations are attainable and could be hazardous on single exposure. The LC50 for rats is >3.0 mg/l. Excessive exposure to isopropanol, a minor component, may cause eye, nose, and throat irritation at around 400 ppm, and at prolonged (hours) and progressively higher levels, incoordination, confusion, hypotension, hypothermia, circulatory collapse, respiratory arrest and even death.

(Continued On Page 4)

(R) Indicates a Trademark of DowElanco

7. FIRST AID: (CONTINUED)

INGESTION: Induce vomiting if large amounts are ingested. Consult medical personnel.

INHALATION: Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, oxygen should be administered by qualified personnel. Call a physician or transport to a medical facility.

NOTE TO PHYSICIAN: No specific antidote. Supportive care. Treatment based on judgment of the physician in response to reactions of the patient.

8. HANDLING PRECAUTIONS:

EXPOSURE GUIDELINE(S): For isopropyl alcohol, the ACGIH TLV and OSHA PEL are 400 ppm TWA, 500 ppm STEL. An exposure guideline has been established for the proprietary component.

VENTILATION: Control airborne concentrations below the exposure guideline. Good general ventilation should be sufficient for most conditions. Local exhaust ventilation may be necessary for some operations.

RESPIRATORY PROTECTION: Atmospheric levels should be maintained below the exposure guidelines. When respiratory protection is required for certain operations, use an approved air-purifying respirator. If respiratory irritation is experienced, use an approved air-purifying respirator.

SKIN PROTECTION: For brief contact, no precautions other than clean body-covering clothing should be needed. When prolonged or frequently repeated contact could occur, use protective clothing impervious to this material. Selection of specific items such as gloves, boots, apron or full-body suit will

(Continued On Page 6)

(R) Indicates a Trademark of DowElanco

REGULATORY INFORMATION: (Not meant to be all-inclusive--selected regulations represented.)

NOTICE: The information herein is presented in good faith and believed to be accurate as the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numberous federal, state or provincial, and local laws and regulations. See MSD Sheet for health and safety information.

U.S. REGULATIONS

==========

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

An immediate health hazard
A delayed health hazard
A fire hazard

TOXIC SUBSTANCES CONTROL ACT (TSCA):

All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

(Continued On Page R-2)
(R) Indicates a Trademark of DowElanco

Specimen Label

Restricted Use Pesticide

May Injure (Phytotoxic) Susceptible, Non-Target Plants. For retail sale to and use only by Certified Applicators or person under their direct supervision and only for those uses covered by the Certified Applicator's certification. Commercial certified applicators must also ensure that all persons involved in these activities are informed of the precautionary statements.

DowElanco™

Tordon* 22K

Herbicide

For use in areas west of the Mississippi River for the control of susceptible broadleaf weeds and woody plants on rangeland and permanent grass pastures, fallow cropland, wheat, barley and oats not underseeded with a legume on grainland (which is not flood or sub-irrigated and not rotated to broadleaf crops), non-cropland, and on Conservation Reserve Program (CRP) acres and wildlife openings in forest and non-crop areas

Active Ingredient:
picloram: 4-amino-3,5,6-trichloropicolinic acid, potassium salt 24.4%
Inert Ingredients.....75.6%
Acid Equivalent
picloram: 4-amino-3,5,6-trichloropicolinic acid - 21.1% - 2 lb per gal

EPA Reg. No. 62719-6

EPA Est. 464-MI-1

Net Contents 2.5 gal

Precautionary Statements

Hazards to Humans and Domestic Animals

Keep Out Of Reach Of Children

WARNING AVISO:

Precaucion al usuario: Si usted no lee inglés, no use este producto hasta que la etiqueta le haya sido explicada ampliamente.

Causes Substantial But Temporary Eye Injury • Harmful If Inhaled Or Absorbed Through Skin

Do not get in eyes or on clothing. Wear goggles, face shield or safety glasses when handling. Avoid contact with skin. Wash thoroughly with soap and water after handling. Remove contaminated clothing and wash before reuse. Avoid breathing spray mist.

First Aid

If in eyes: Flush with plenty of water for at least 15 minutes. Get medical attention.

Environmental Hazards

Do not apply directly to water or wetlands (swamps, bogs, marshes, and potholes). Do not contaminate water when disposing of equipment washwaters. Do not contaminate water used for irrigation or domestic purposes by cleaning of equipment or disposal of wastes. Do not allow run-off or spray to contaminate wells, irrigation ditches or any body of water used for irrigation or domestic purposes. Do not make application when circumstances favor movement from treatment site.

Picloram is a chemical which can travel (seep or leach) through soil and under certain conditions has the potential to contaminate groundwater which may be used for irrigation and drinking purposes. Users are advised not to apply picloram where soils have a rapid to very rapid permeability throughout the profile (such as loamy sand to sand) and the water table of an underlying aquifer is shallow or to soils containing sinkholes over limestone bedrock, severely fractured surfaces, and substrates which would allow direct introduction into an aquifer. Your local agricultural agencies can provide further information on the type of soil in your area and the location of groundwater.

An aquifer is defined as "an underground, saturated, permeable, geologic formation capable of producing significant quantities of water to a well or spring. It is the ability of the saturated zone, or portion of that zone, to yield water which makes it an aquifer" (American Chemical Society, 1983).

Note: Use in Hawaii limited exclusively to Supplemental Labeling. See "General Use Precautions" for details.

Notice: Read the entire label. Use only according to label directions. **Before buying or using this product, read "Warranty Disclaimer" and "Limitation of Remedies"sections elsewhere on this label.**

In case of emergency endangering health or the environment involving this product, call collect 517-636-4400.

Agricultural Chemical: Do not ship or store with food, feeds, drugs or clothing.

Tordon* 22K

Do not apply or otherwise permit Tordon 22K or sprays containing Tordon 22K to contact crops or other desirable broadleaf plants, including but not limited to alfalfa, beans, grapes, melons, peas, potatoes, safflower, soybeans, sugar beets, sunflower, tomatoes, and other vegetable crops, flowers, fruit plants, ornamentals or shade trees or the soil containing roots of nearby valuable plants.

Precautions for Avoiding Injurious Spray Drift

Applications should be made to avoid spray drift since very small quantities of spray, which may not be visible, may seriously injure susceptible crops during both growing and dormant periods. To minimize spray drift, use low nozzle pressure; apply as a coarse spray; and use nozzles designed for herbicide application that do not produce a fine droplet spray. To aid in further reducing spray drift, a drift control and deposition aid such as Nalco-Trol may be used with this product. If such a drift control aid is used, follow all use recommendations and precautions on the product label.

Ground Equipment: With ground equipment spray drift can be lessened by keeping the spray boom as low as possible; by applying 20 gallons or more of spray per acre; by keeping the operating spray pressures at the manufacturers recommended minimum pressures for the specific nozzle type used (low pressure nozzles are available from spray equipment manufacturers); by spraying when the wind velocity is low (follow state regulations). Avoid calm conditions which may be conducive to air inversions. In hand-gun applications, select the minimum spray pressure that will provide adequate plant coverage (without forming a mist).

Aerial Application: With aerial applications, drift may be lessened by using a coarse spray; by using a drift control system; or by using Nalco-Trol drift control additive or equivalent. Adjust spray pressure to provide coarse spray droplets and by using nozzles which do not create fine droplets. Spray boom should be no longer than 3/4 of the wingspan or rotor length. Do not use a thickening agent with the Microfoil or the Thru-Valve booms, or other systems that cannot accommodate thick sprays. Spray only when the wind velocity is low (follow state regulations). Avoid calm conditions which may be conducive to air inversions.

Determine Air Movement and Direction Before Foliar Application. Do not spray when wind is blowing toward susceptible crops or ornamental plants near enough to be injured. It is suggested that a continuous smoke column at or near the spray site or a smoke generator on the spray equipment be used to detect air movements, lapse conditions, or temperature inversions (stable air). If the smoke layers or indicates a potential of hazardous spray drift, do not spray.

Do not contaminate water intended for irrigation or domestic purposes. To avoid injury to crops or other desirable plants, do not treat or allow spray drift or run-off to fall onto banks or bottoms of irrigation ditches, either dry or containing water, or other channels that carry water that may be used for irrigation or domestic purposes.

Do not use on flood or sub-irrigated land.

Do not spray if the loss of forage legumes cannot be tolerated. Tordon 22K may injure or kill legumes. New legume seedlings may not grow for several years following application of this herbicide.

Do not use manure from animals grazing treated areas on land used for growing broadleaf crops, ornamentals, orchards or other susceptible, desirable plants. Manure may contain enough picloram to cause injury to susceptible plants.

Do not use grass or hay from treated areas for composting or mulching of susceptible broadleaf crops.

Do not transfer livestock from treated grazing areas onto sensitive broadleaf crop areas without first allowing 7 days of grazing on an untreated grass pasture. Otherwise, urine may contain enough picloram to cause injury to sensitive broadleaf plants.

Do not apply to snow or frozen ground. Application during very cold (near freezing) weather is not advisable.

Tordon 22K should not be applied on residential or commercial lawns or near ornamental trees and shrubs. Untreated trees can occasionally be affected by root uptake of herbicide through movement into the top soil or by excretion of the product from the roots of nearby treated trees. Do not apply Tordon 22K within the root zone of desirable trees unless such injury can be tolerated.

Do not rotate food or feed crops on treated land if they are not registered for use with picloram until an adequately sensitive bioassay or chemical test shows that no detectable picloram is present in the soil.

Do not move treated soil to areas other than those treatment sites for which Tordon 22K is registered for use. Also, do not use treated soil to grow plants for which use of Tordon 22K is not registered until an adequately sensitive bioassay or chemical test shows that no detectable residue of picloram is present in the soil.

Woody Plants and Broadleaf Weeds Controlled by Tordon 22K

Woody Plants:

absinth wormwood
aspen
blackberries
catclaw acacia
chaparral sp.
fringed sagebrush
gorse
junipers/cedars
locust
multiflora rose
pinyon pine
rabbitbrush
Scotch broom

Annual and Perennial Broadleaf Weeds:

brackenfern
buckwheat, wild
buffalobur
bursage
burroweed
camelthorn
clover
crupina, common
dock
field bindweed
goldenrod
henbane, black
horsenettle
  Carolina
  white
horseweed
ironweed
knapweed
  diffuse
  Russian
  spotted
  squarrose
larkspurs
  geyer
  plains
  tall
lambsquarters
leafy spurge
licorice, wild
locoweeds
lupines
milkweed
ox-eye daisy
pigweed
pricklypear cactus
ragweeds
  common
  bur
  lanceleaf
  western
rush skeletonweed
Russian thistle
snakeweeds
sowthistle
starthistles
  Iberian
  purple
  yellow
St. Johnswort
sulfur cinquefoil
sunflower
tansy ragwort
tasajillo
toadflaxes
thistles
  artichoke
  beaumont
  bull
  Canada
  distaff
  golden
  Italian
  musk
  plumeless
  Scotch
  wavy leaf

Mixing and Application Methods

Mix the required amount of Tordon 22K in water and apply as a coarse low pressure spray using ground equipment or aircraft. Use enough spray volume to provide uniform coverage of the weeds. For best results treat when the weeds are growing actively in the spring before full bloom or late summer into fall. Treatments during full bloom or seed stage of some weeds may not give good control.

To prepare the spray, add about half the desired amount of water in the spray tank. Then with agitation, add the recommended amount of Tordon 22K and other registered tank mix herbicides. Finally, with continued agitation, add the rest of the water and additives such as surfactants or drift control and deposition aids.

Use with surfactants

Addition of wetting or penetration agents is not usually necessary when using Tordon 22K. Under extreme conditions, such as drought, addi-

Weed Control Guidelines for Tordon 22K in Non-cropland, Rangeland and Pasture

Weed Species**	Rate per Acre	Comments
biennial thistles bull musk plumeless Scotch	Fall: 1/2 pint Spring: 6 - 8 fl oz with 1.0 lb ae 2,4-D	Apply when thistles are in the rosette stage before bolting in the spring or in the fall prior to soil freeze up.
bolted musk thistle	1/2 - 1 pint + 1 lb ae 2,4-D per acre	Apply before flowering.
broom snakeweed geyer larkspur locoweeds multiflora rose plains larkspur prickly pear cactus sulfur cinquefoil	1 pint	For pricklypear cactus, use of a diesel oil-water emulsion spray mixture may improve control.
black henbane crupina diffuse knapweed spotted knapweed yellow starthistle	1 - 2 pints	
absinth wormwood bursage Douglas rabbitbrush goldenrod ox-eye daisy	1 - 2 pints	Tank mix the lower rate with 1.0 lb ae per acre 2,4-D. Lower rates may require annual spot treatments.
wild licorice	1 quart	
Canada thistle field bindweed gorse lupines rush skeletonweed St. Johnswort tansy ragwort	1 - 2 quarts	Tank mix the lower rate with 1.0 lb ae per acre 2,4-D. Lower rates may require annual spot treatments.
dalmation toadflax juniper perennial sowthistle Russian knapweed	2 - 3 quarts	For Russian knapweed, apply at bud stage or in the fall
tall larkspur yellow toadflax	3 - 4 quarts	
leafy spurge	1 - 4 quarts	Lower rates will require annual retreatment for several years. Retreat when control drops below 80%

*For additional species or more specific rates consult your area's current Weed Control Guide and/or your local DowElanco representative.

**Many seedling annual weeds can be controlled using 1 pt per acre.

For rates exceeding 1 quart per acre, apply only as a spot treatment and the total area treated in a single season should not exceed 25% of a landowner's acreage found in any particular watershed.

Spot Treatment

See "Spot Treatment" in "Mixing and Application Methods" section for directions for calibration, spray volume determination and mixing.

Spot Concentrate Application

Eastern red cedar can be controlled with spot concentrate applications of Tordon 22K in either the spring (April-May) or fall (September-October). For best results, use 3 ml to 4 ml of Tordon 22K **(undiluted)** per 3 feet of plant height. Application should precede periods of expected rainfall. Apply directly to soil within the dripline and on the upslope side of the tree. Application to trees taller than 15 feet is not recommended. **Do not** use more than 2 pints of Tordon 22K per acre in any one year.

Wick Application

See "Wick Application" in "Mixing and Application Methods" section for directions. Apply when weeds are actively growing and are above most desirable plants. For ironweed and goldenrod, best results are obtained with applications made prior to early bud stage.

Barley, Oats, and Wheat Not Underseeded With a Legume (Which is Not Flood or Sub-Irrigated and Not Rotated to Broadleaf Crops)

Use Tordon 22K for the control of susceptible annual broadleaf weeds such as (but not limited to) volunteer sunflower, wild buckwheat, lambsquarters, pigweed, Russian thistle, and sowthistle.

Use Precautions

Do not apply Tordon 22K within 50 days before harvest.

Spray mixtures may cause shorter straw on some varieties of cereals but grain yields are usually not affected.

Do not graze or feed forage from treated areas for 2 weeks after treatment. Do not harvest hay from treated grain fields.

Use only on land that will be planted the following year to grass, barley, oats, wheat or fallowed. Do not apply more than 1 1/2 fluid ounces of Tordon 22K per acre during the small grain growing season.

Broadcast Treatment (Ground and Aerial Applications)

Tordon 22K can be applied as a single broadcast treatment by ground or aerially to control several broadleaf weeds by itself or as a tank mix with 2,4-D, MCPA, or sulfonylurea herbicides such as Ally. Apply Tordon 22K at the rates suggested in the following table in 2 to 5 gallons of water per acre by air or in 5 to 20 gallons of water per acre by ground. The addition of surfactants may aid control under dry conditions, but may cause injury to grain if used over the top. Read and follow directions and precautions on other product labels when tank mixing.

Spring Wheat, Barley and Oats

Apply from the 3 to 5 leaf stage to the early jointing stage of growth as indicated in the table below. Applications at the 3 to 5 leaf stage occasionally cause slight head malformations and straw shortening but normally do not affect yield.

Durum Wheat

Do not treat durum wheat since some varieties of durum wheat may be injured.

Winter Wheat and Barley

Apply after resumption of active growth in the spring until the early jointing stage.

Broadcast Treatment (Ground and Aerial Applications)

Applications of Tordon 22K should be made after perennial grasses are well established (have developed a good secondary root system and show good vigor). Most perennial grasses show improved tolerance to the herbicide at this stage of development.

For control of actively growing perennial weeds, use up to 1 quart per acre of Tordon 22K after the grass is established. For best results, use in 2 or more gallons of water per acre by air or in 5 or more gallons of water per acre by ground. Increasing the rate of application can increase the risk of injury.

For control of actively growing susceptible annual broadleaf weeds, (including Russian thistle) apply 1/4 to 1/2 pint per acre of Tordon 22K. Tordon 22K can also be tank mixed with 1/2 to 1 pound per acre of 2,4-D where 2,4-D sensitive species present. Read and follow all directions for use and use precautions on other product labels.

Spot Treatment

See "Spot Treatment" in "Mixing and Application Methods" section for directions for calibration, spray volume determination and mixing.

For spot applications when perennial grasses are established, use 1 to 8 pints per acre of Tordon 22K. Rates of 2 quarts per acre or more should only be used for control of deep-rooted perennial broadleaf weeds.

Tordon 22K at rates over 2 pints per acre may suppress certain established grasses such as bromegrass, bluegramma and buffalograss. However, subsequent grass growth should be improved by release from weed competition.

Wick Application

See "Wick Application" in "Mixing and Application Methods" section for directions. Apply when weeds are actively growing and are above most desirable plants. For ironweed and goldenrod, best results are obtained with applications made prior to early bud stage.

Warranty Limitations and Disclaimer

DowElanco warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes stated on the label when used in strict accordance with the directions, subject to the inherent risks set forth below. DOWELANCO MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY.

Inherent Risks of Use

It is impossible to eliminate all risks associated with use of this product. Plant injury, lack of performance, or other unintended consequences may result because of such factors as use of the product contrary to label instructions (including conditions noted on the label, such as unfavorable temperature, soil conditions, etc.), abnormal conditions (such as excessive rainfall, drought, tornadoes, hurricanes), presence of other materials, the manner of application, or other factors, all of which are beyond the control of DowElanco or the seller. All such risks shall be assumed by Buyer.

Limitation of Remedies

The exclusive remedy for losses or damages resulting from this product (including claims based on contract, negligence, strict liability, or other legal theories), shall be limited to, at DowElanco's election, one of the following:

1. Refund of purchase price paid by buyer or user for product bought, or
2. Replacement of amount of product used.

DowElanco shall not be liable for losses or damages resulting from handling or use of this product unless DowElanco is promptly notified of such loss or damage in writing. In no case shall DowElanco be liable for consequential or incidental damages or losses.

The terms of the "Warranty Disclaimer" above and this "Limitation of Remedies" cannot be varied by any written or verbal statements or agreements. No employee or sales agent of DowElanco or the seller is authorized to vary or exceed the terms of the "Warranty Disclaimer" or this "Limitation of Remedies" in any manner.

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LABEL CODE 112-42-002 DATE CODE 292
EPA APPROVAL 12/20/91 REPLACES 112-42-001

Revisions Include:
1) Label reformatted and edited for clarity.
2) Updated woody plants and broadleaf weeds controlled listed.

DowElanco

MATERIAL SAFETY DATA SHEET

DOWELANCO INDIANAPOLIS, IN 46268 EMERGENCY (517) • 636 • 4400

Product Code: 87116

Product Name: TORDON (R) 22K WEED KILLER

Effective Date: 07/16/92 Date Printed: 02/11/93 MSDS:000380

1. INGREDIENTS: (% w/w, unless otherwise noted)

4-Amino-3,5,6-trichloropicolinic acid, (picloram) Potassium salt	CAS# 002545-60-0	24.4%
Inerts		75.6%
Water	CAS# 007732-18-5	
Plus proprietary dispersing agents		

This document is prepared pursuant to the OSHA Hazard Communication Standard (29 CFR 1910.1200). In addition, other substances not 'Hazardous' per this OSHA Standard may be listed. Where proprietary ingredient shows, the identity may be made available as provided in this standard.

2. PHYSICAL DATA:

BOILING POINT: IBP 212F, 100C
VAP. PRESS: Approx. 23 mmHg @ 20C
VAP. DENSITY: Not applic.
SOL. IN WATER: Infinite
SP. GRAVITY: 1.160 (68/68F, 20C)
APPEARANCE: Brown liquid.
ODOR: Not available.

3. FIRE AND EXPLOSION HAZARD DATA:

FLASH POINT: None observed up to 214F (TCC).
METHOD USED: TCC

FLAMMABLE LIMITS
LFL: Not determined
UFL: Not determined

(Continued On Page 2)
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6. HEALTH HAZARD DATA:

EYE: May cause severe eye irritation. Corneal injury is unlikely. Effects likely to heal readily.

SKIN CONTACT: Prolonged or repeated exposure may cause skin irritation, even a burn.

SKIN ABSORPTION: A single prolonged skin exposure is not likely to result in absorption of harmful amounts. The LD50 for skin absorption in rabbits is >2000 mg/kg.

INGESTION: Single dose oral toxicity is extremely low. The oral LD50 for male and female rats is >5000 mg/kg. Small amounts swallowed incidental to normal handling operations are not likely to cause injury; swallowing amounts larger than that may cause injury.

INHALATION: Single exposure to vapors is not likely to be hazardous.

SYSTEMIC (OTHER TARGET ORGAN) EFFECTS: Repeated excessive exposures to high amounts may cause liver effects.

CANCER INFORMATION: Did not cause cancer in long-term animal studies.

TERATOLOGY (BIRTH DEFECTS): Birth defects are unlikely. Even exposures having an adverse effect on the mother should have no effect on the fetus.

REPRODUCTIVE EFFECTS: No relevant information found.

MUTAGENICITY (EFFECTS ON GENETIC MATERIAL): The preponderance of data shows picloram to be non-mutagenic in 'in vitro' (test tube) tests and in test animals and is therefore believed to pose no mutagenic risk.

(Continued On Page 4)

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8. HANDLING PRECAUTIONS: (CONTINUED)

clothing impervious to this material. Selection of specific items such as gloves, boots, apron or full-body suit will depend on operation.

EYE PROTECTION: Use chemical goggles, safety glasses, or face shield when handling, depending on the type of handling operation.

9. ADDITIONAL INFORMATION:

SPECIAL PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Keep out of reach of children. Avoid contact with skin and eyes. Provide eye fountain and washing facilities near work area. Do not ship or store with food, feeds, drugs or clothing. Do not contaminate irrigation or domestic water, food or feed by storage or disposal.

MSDS STATUS: Sections 6, 8 and regsheet Revised 7/92.

For information regarding state/provincial and federal regulations see the Regulatory Information Section.
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REGULATORY INFORMATION: (Not meant to be all-inclusive--selected regulations represented.)

NOTICE: The information herein is presented in good faith and believed to be accurate as the effective date shown above. However, no warranty, express or implied, is given. Regulatory requirements are subject to change and may differ from one location to another; it is the buyer's responsibility to ensure that its activities comply with federal, state or provincial, and local laws. The following specific information is made for the purpose of complying with numberous federal, state or provincial, and local laws and regulations. See MSD Sheet for health and safety information.

U.S. REGULATIONS

==========

SARA HAZARD CATEGORY: This product has been reviewed according to the EPA "Hazard Categories" promulgated under Sections 311 and 312 of the Superfund Amendment and Reauthorization Act of 1986 (SARA Title III) and is considered, under applicable definitions, to meet the following categories:

An immediate health hazard
A delayed health hazard

TOXIC SUBSTANCES CONTROL ACT (TSCA):

All ingredients are on the TSCA inventory or are not required to be listed on the TSCA inventory.

OSHA HAZARD COMMUNICATION STANDARD:

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APPENDIX E. CHEMICAL WEED CONTROL GUIDELINES FOR MAJOR WEEDS ON REGION 2 FWP SITES (Montana Weed Control Guides, MSU Cooperative Extension Service, MSU, Bozeman, MT 1992)

CANADA THISTLE

* clopyralid (Stinger)

Rate:	2/3 to 1 1/3 pt/A (pasture and rangeland) 1/4 to 1/2 pt/A (noncropland)
Time:	Apply after a majority of basal leaves have emerged, but before bud stage.
Caution:	Do not apply more than once per season.
Tank Mix:	1/2 to 2 lb ae of 2,4-D (noncropland)

* dicamba (Banvel)

Rate:	1 to 2 qt/A
Time:	Apply to fall regrowth or when thistles are in the rosette stage and before a hard-killing frost or in bud stage.

*** dicamba** (Banvel) - continued

Caution: Remove meat animals from treated areas 30 days prior to slaughter. Consult label for dairy animal grazing restrictions.

Tank Mix: 1 to 2 qt/A of Banvel + 1 lb ae/A qt of 2,4-D.

*** glyphosate** (Roundup)

Rate: 2 to 3 qt/A.
Or, 2% solution (spray to wet foliage).

Time: Apply when majority of thistles are at or beyond bud stage or in fall before a hard-killing frost.

Remarks: For spot-treatment. All vegetation in treated areas will be killed. Avoid drift.

Caution: Do not graze or harvest forage for 2 weeks after application. Do not treat more than 1/10 of any one acre at one time.

*** MCPA iso-ocytl ester** (Several trade names)

Rate: 3 lbs ae/A in sufficient water to provide thorough coverage.

Time: When weeds are in bud to early bloom.

Caution: Do not graze dairy animals on treated areas within 7 days of application.

*** picloram** (Tordon)

Rate: 1 to 2 qt/A 22K.

Time: Apply in the fall or spring when thistles are actively growing.

Caution: **A restricted-use herbicide.** Carefully read and observe all label restrictions.

Tank Mix: 1 qt/A of Tordon 22K + 1 lb ae/A of 2,4-D.

*** 2,4-D amine or ester** (Several trade names)

Rate: 1 to 2 lb ae/A.

Time: Apply when thistles are in bud stage and in fall.

Remarks: Suppression only. Better control is obtained if treated twice a year, in the bud stage in spring and again in fall. Plan to treat for several consecutive years.

Caution: Do not graze dairy animals on treated areas within 7 days of application.

DALMATION TOADFLAX

*** glyphosate** (Roundup)

Rate: 4 to 5 qt/A.

Or, a 2% solution (spray to wet foliage).

Time: Apply between bud and bloom stage or in fall while actively growing.

Remarks: For spot-treatment. Provides suppression only.

Caution: All vegetation in treated area will be killed. Avoid drift. Do not graze or harvest forages for 2 weeks after application. Do not treat more than 1/10 of any one acre at one time.

*** picloram** (Tordon)

Rate: 1 to 3 qt/A of 22K.

Time: In rosette stage in spring or fall.

Remarks: Suppression only. Repeat applications are necessary.

Caution: **A restricted-use herbicide.** Forage grasses may be injured on low organic matter or sandy textured soils at these Tordon rates. Consult Montana Special Local Need label. Carefully read and observe all label restrictions.

DYERS WOAD

dicamba (Banvel)

Rate: 1 to 2 qt/A.

Time: Apply between bud and bloom stage and in fall.

Remarks: Annual applications are necessary to control new seedlings. Growth starts in early spring and flowering and seed production occur before most other plants. Use 1/2% surfactant for improved control.

Caution: Remove meat animals from treated areas 30 days prior to slaughter. Consult label for dairy animal grazing restrictions.

*** 2,4-D amine or ester** (Several trade names)

Rate: 1 to 1 1/2 lb ae/A.

Time: Apply at rosette stage, before 4 inches tall in spring.

Remarks: Annual applications are necessary to control new seedlings. Growth starts in early spring and flowering and seed production occur before most other plants. Addition of 1/2 pt/A of Banvel will increase the effectiveness of late applications.

Caution: Do not graze dairy animals on treated areas within 7 days of application.

FIELD BINDWEED

*** dicamba** (Banvel)

Rate: 1 to 2 qt/A.

Time: Apply during vigorous fall growth or in summer when plants are in or beyond the full bloom stage.

Remarks: Mid to late fall treatments have been most effective. Repeat applications are necessary for complete control. Rate depends on weed density, see label.

Caution: Banvel rates above 2 qts/A may cause temporary injury to forage grasses. Remove meat animals from treated areas 30 days prior to slaughter. Consult label for dairy animal grazing restrictions.

Tank Mix: 1 to 2 qt/A of Banvel + 1 to 2 lb ae/A of 2,4-D.

*** glyphosate** (Roundup)

Rate: 4 to 5 qt/A.

Or, 2% solution (spray to wet foliage).

Time: Apply late summer or fall when actively growing.

Remarks: For spot-treatment. Repeat applications are necessary for complete control.

Caution: All vegetation in treated area will be killed. Avoid drift. Do not graze or harvest forages for 2 weeks after application. Do not treat more than 1/10 of any one acre at one time.

*** picloram** (Tordon)

Rate: 1 to 2 qt/A of 22K.

Time: Apply in fall or spring when actively growing.

Remarks: Lower rates will require annual re-treatment for several years.

Caution: **A restricted-use herbicide.** Carefully read and observe all label restrictions.

Tank Mix: 1 qt/A of Tordon 22K + 1 lb ae/A of 2,4-D.

*** 2,4-D amine or ester** (Several trade names)

Rate: 1 to 2 lb ae/A.

Time: Apply between bud and bloom stage and in fall.

FIELD BINDWEED - continued

*** 2,4-D amine or ester** (Several trade names) - continued

Remarks: Suppression only. Better control is obtained if treated twice a year, in the bud stage in late spring and again in fall. Plan to treat for several consecutive years.

Caution: Do not graze dairy animals on treated areas within 7 days of application.

KNAPWEED, DIFFUSE OR SPOTTED

*** clopyralid** (Stinger)

Rate: 12 fl oz/A (pasture and rangeland).

12 fl oz/A (noncropland).

Time: Apply in the rosette stage (spring and fall) to midbolt stage (spring).

Remarks: Annual treatment necessary to control new seedlings.

Caution: Do not apply more than once per season.

Tank mix: 1/2 to 2 lb ae of 2,4-D (noncropland).

*** clopyralid +2,4-D** (Curtail)

Rate: 2 qt/A (non-cropland)
2 to 4 qt/A (rangeland and pasture)

Time: Apply from rosette (spring or fall) to midbolt (spring).

Remarks: Annual treatment necessary to control new seedlings.

Caution: If within 2 weeks of application, remove meat animals from treated areas 7 days prior to slaughter.

*** dicamba** (Banvel)

Rate: 2 to 3 pt/A.

Time: Apply in rosette stage in fall or spring.

Remarks: Annual treatments necessary to control new seedlings.

Caution: Remove meat animals from treated areas 30 days prior to slaughter. Consult label for dairy animal grazing restrictions.

Tank Mix: 1 to 2 pt/A of Banvel + 1 to 2 lb ae/A of 2,4-D.

*** picloram** (Tordon)

Rate: 1 to 1 1/2 pt/A of 22K.

Time: Apply in fall or spring through June while actively growing. Optimum time is rosette to prebud.

Remarks: Provides residual control for 2 to 5 years depending upon soil type.

Caution: **A restricted-use herbicide.** Carefully read and observe all label restrictions.

KNAPWEED, DIFFUSE OR SPOTTED - continued

*** 2,4-D amine or ester** (Several trade names)

Rate: 2 lb ae/A.

Time: Apply in the rosette stage in fall or spring.

Remarks: Annual treatment necessary to control new seedlings.

Caution: Do not graze dairy animals on treated areas within 7 days of application.

LEAFY SPURGE

*** picloram** (Tordon)

Rate: 1 to 4 qt/A.

Time: Apply to actively growing spurge in spring or fall.

Remarks: Lower rates will require annual retreatment for several years. Retreat when control drops below 80%. Addition of 2,4-D may improve control at lower rates. Use 4 qt/A when treating small patches.

Caution: **A restricted-use herbicide.** Forage grasses may be injured on low organic matter or sandy textured soils at higher Tordon rates. Carefully read and observe all label restrictions.

Tank Mix: 1 to 2 pt/A of picloram + 1 lb ae/A of 2,4-D.

*** 2,4-D ester** (Several trade names)

Rate: 1 to 2 lb ae/A.

Time: Apply during early bud stage and in fall.

Remarks: Suppression only. Apply every year in both spring and fall for satisfactory control.

Caution: Do not graze dairy animals on treated areas within 7 days of application.

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APPENDIX F.

SITE SPECIFIC WEED MANAGEMENT INVENTORY AND PRESCRIPTION

SITE: _____

NAME: _____ DATE: _____

ACREAGE: _____ AVERAGE SLOPE OR RANGE: _____

ELEVATION: _____ ASPECT(S): _____

GENERAL VEGETATION: (ATTACH SITE SKETCH IF NEEDED)

FOREST____% RANGE____% RIPARIAN____% OTHER____%

VEGETATION HABITAT TYPES: _____

_____

PAST WEED CONTROL: _____

_____

_____

GENERAL SURFACE AND GROUNDWATER CONDITIONS: (ATTACH SKETCH IF NEEDED)

_____

_____

_____

GENERAL SOIL CONDITIONS:

_____

_____

WEED SPECIES: (COVERAGE CLASSES ARE R=RARE, F=FEW, C=COMMON, A=ABUNDANT)

WEED SPECIES	COVERAGE CLASS	ACRES	OTHER INFORMATION

WEED SPECIES (CONT.)

MAJOR VEGETATION (ATTACH SITE MAP IF POSSIBLE):

PLANT SPECIES	COVERAGE CLASS	OTHER INFORMATION

THREATENED, ENDANGERED AND OTHER SPECIES OF SPECIAL CONCERN:

PLANT SPECIES	COVERAGE CLASS	OTHER INFOMATION (LOCATION)

SITE TREATMENT PRIORITY

WEED CONTROL PRESCRIPTIONS BY MANAGEMENT ZONE (ATTACH MAP OF MZs)

MANAGEMENT ZONE 1

MANAGEMENT ZONE 2

MANAGEMENT ZONE 3

MANAGEMENT ZONE 4

(POTENTIAL MAPS TO ATTACH: MANAGEMENT ZONES, WEED DISTRIBUTION, TES DISTRIBUTION, OWNERSHIP, TOPOGRAPHY)

SITE: _____ INFORMATION: _____

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APPENDIX G. WEED CONTROL EFFECTIVENESS MONITORING

Monitoring is essential to document the effectiveness of weed control efforts. Data can be used to refine program specifications choose alternatives. Monitoring may range from photographs at reference points and notes on general observations of weed presence and density to statistically valid documentation of plant community changes and larger ecosystem effects.

EXAMPLE MEDIUM-INTENSITY PLOT MONITORING METHODS

1 Select monitoring sites within treatment zones which can be easily relocated.

2 Choose a starting point which is easy to locate.

3 Layout a transect and locate microplots at regular intervals.

4 Use a plot frame of .5 square meters or similar standard size and estimate the canopy coverage of each major weed as well as "other forbs", "grass" and "bare soil/rock". Other categories may be needed on some sites.

5 Note the presence of non-target species.

6 Photograph along transect from starting point.

7 Compute means and standard deviations then compare coverage results before and after treatments. Compare species lists to evaluate the impacts on non-target species.

EXAMPLE WEED CONTROL MONITORING FORM

SITE: _____ **DATE:** _____

PLOT NO: _____ **NAME:** _____

STARTING POINT: _____

_____

DIRECTION: _____

% CANOPY COVERAGE - RECORD 20 READINGS FOR EACH

MAJOR WEEDS											MEAN
SPOTTED KNAPWEED											
LEAFY SPURGE											
CANADA THISTLE											
OTHER WEEDS											
GRASSES											
OTHER FORBS											
BARE SOIL/ROCK											

OTHER WEEDS

NON-TARGET PLANTS:

NOTES: _____

_____

_____

_____

APPENDIX I

APPENDIX H

APPENDIX H. PESTICIDE SPILL RESPONSE PLAN

This plan includes reporting and response procedures to follow in the event of a pesticide spill. This plan applies to all FWP personnel and contractors when an accident occurs involving the transport, application, use or handling of a pesticide. Included are emergency response telephone numbers, field personnel duties and spill documentation procedures.

IN THE EVENT OF A SPILL - IMMEDIATELY

1. **Administer First Aid to Injured or Contaminated Persons**
2. **Identify Type of Pesticide Released**
3. **Notify the Appropriate Authorities**
4. **Quarantine the Area**
5. **Contain the Spill if Possible**
6. **Complete Pesticide Emergency Response Record**
7. **Develop a Clean-Up Plan Where Appropriate**

The first priority in pesticide emergencies is protection of personnel involved in the accident, spill containment and clean-up. The next priority is minimizing environmental contamination. Injured parties should be moved from the contaminated area immediately and contaminated clothing removed. The chemical should be identified and first aid administered based on label information and material safety data sheets. Initial first aid for skin contact usually includes washing with water and detergent. Initial first aid for eye contact usually includes rinsing with eye-safe solutions or water. Transport injured parties to medical facilities as soon as possible and send information on the chemical, especially the name, label, and material safety data sheet.

Restrict access to the site as needed using physical barriers and/or signs. Avoid contact with spilled material until it is positively identified. Only personnel with appropriate protective clothing should enter the spill area.

All FWP personnel and contractors who transport, apply, handle and use pesticides must carry a spill response kit including those items on the attached list. A pesticide emergency report form will be completed for all spill, accidents or other emergencies or material releases involving pesticides.

The improper use or accidental release of a pesticide may pose a serious health or environmental hazard. Accidental spills and releases must be responded to quickly and procedures exercised efficiently to ensure the protection of human health and the environment. Additional information on the handling and use of pesticides can be found in the Montana Pesticide Act (80.8.101 MCA) and its Administrative Rules (ARM 4.10.101)

1. ADMINISTER AID TO INJURED PERSONS

Of greatest importance is the immediate threat to human health and the aid of someone injured from a pesticide spill. Any injured parties should be removed from the contaminated area immediately. Contaminated clothing should be removed. If the released chemical is known, the appropriate procedures for administering first aid and decontamination will be described on label information and material safety data sheets. For most pesticides, washing with water and detergent is the best method. Injured parties, should be transported to medical facilities as soon as possible, with the name of the released material, label, and material safety data sheet accompanying the injured person.

2. IDENTIFY SPILLED MATERIAL

To administer the most appropriate emergency response, the spilled pesticide must be accurately identified. Pesticide label information and Material Safety Data Sheets (MSDS) should accompany all FWP personnel and their contractors if a pesticide is handled, transported, applied or used. The MSDS sheets will provide information concerning appropriate response procedures for administering emergency aid to affected parties and appropriate protective clothing for containing a spill. The transporter and applicator of the pesticide must carry records describing mixtures of all pesticides applied.

3. NOTIFY AUTHORITIES

Pesticides can pose serious threats to human health and the environment and should be handled with extreme care. In the event of a release, follow these specific notification procedures. The following authorities may be contacted as indicated below:

FWP CONTACT: Maintenence Supervisor

Local Emergency Response		**911**
or		
County Sheriff, if in:	**Deer Lodge**	**563-5421**
	Granite	**288-3542**
	Missoula	**721-5700**
	Mineral	**822-4861**
	Powell	**846-2711**
	Ravalli	**363-3033**

Montana Disaster & Emergency Services	**(406) 444-6911**
National Response Center	**(800) 424-8802**
Montana Department of Agriculture	(406) 444-3144

All pesticide spills and releases must be reported to the Montana Department of Agriculture within 48 hours. The written report must include the time of the incident, its location, pesticide name, type of formulation, method of application, and the FWP

contact for the project. The report should also include all parties involved in the incident including the names and addresses of affected parties where the spill occurred. If the spilled pesticide is classified as either extremely toxic or highly toxic, the Department of Agriculture must be notified immediately.

OPTIONAL INFORMATION SOURCES

Below are other information sources for responding to and cleaning up pesticide spills.

CHEMTREC (800) 424-9300

The Chemical Manufacturer's Association maintains this 24 hour information hotline to fire and police crews responding to chemical accidents and spills and provide information about chemicals and their related health and environmental hazards.

Montana Poison Control Center (800) 525-5042

For specific information about response procedures and first aid for injured or contaminated persons.

Montana Environmental Management Division (406) 444-2944

For notifying appropriate environmental agencies concerning pesticide spills and accidents.

4. CONTAIN SPILL

Spill material must be contained as soon as possible. The spilled material must be identified first, prior to any containment begins. Technical labels and MSDS provide information on protective clothing requirements for clean-up personnel. Generally, these requirements will be similar to protective clothing requirements for applying the pesticide and will already be available at the site.

Put on all necessary protective clothing, including respirators, before approaching the spill. Approach the spill from an upwind direction. Avoid inhaling fumes, vapors, and dust from the spill. Smoking is not allowed in a spill area.

Potential Spill Containment Methods

Liquid Spills:

- create small collections pools for runoff
- create dikes to impound runoff
- cover spill material with approximately double its volume in absorbent material (hydrated lime, saw dust, kitty litter)
- in sandy soils, transfer absorbent onto an impermeable barrier (tarp)
- divert spilled material away from open waters
- monitor and plug leaks in containment structures

Dry Spills:

- cover with a plastic tarp and secure edges of the tarp
- spray fine mist to minimize dust
- shovel material into clearly marked plastic bags or drums and seal

Any person that attempts to contain a spilled pesticide should also follow these guidelines:

- minimize human contact with the spill, use mechanized equipment if possible
- all absorbent material, used in containment, must be treated as a hazardous waste
- avoid raising dust
- do not dilute material with water (except for misting dry substances)
- all contaminated soil must be removed and disposed as a hazardous waste
- do not consume any food until hands and face have been thoroughly washed and properly decontaminated

5. QUARANTINE AREA

In the event of a spill, the area should be secured to avoid unauthorized personnel entering the spill area. Only authorized persons with the appropriate protective clothing should be permitted into the spill area. Put up physical barriers such as emergency tape, flagging, and signs.

6. RECORD PESTICIDE SPILL

A pesticide spill or accident could potentially have effects that last longer than immediate health and environmental threats. It is important to document all events concerning the accident and spill. Important information should include the name and type of pesticide (include MSDS sheets), any injured or contaminated persons, amount spilled or released, where it was spilled, entry into a water body and other important information. Below is a reporting form to ensure all of the appropriate information has been documented.

PESTICIDE SPILL EMERGENCY RESPONSE FORM

Complete all appropriate items and add additional notes to document special conditions or unusual circumstances. Take photos when possible to supplement notes.

1. Immediately contact the appropriate response agencies.

2. Were there injuries related to the spill? ___yes ___no
   Were any individuals contaminated with pesticide? ___yes ___no
   Was aid provided to affected individuals? ___yes ___no
   Was transportation to a medical facility required? ___yes ___no

3. Was a vehicle accident involved? ___yes ___no

4. What materials/pesticides were involved? (include MSDS)
   _____

5. Estimate amount of pesticide or pesticide mixture spilled in gallons.
   Pesticide: _____ ____ gals – Mixture: _____ ____ gals
   Pesticide: _____ ____ gals – Mixture: _____ ____ gals
   Pesticide: _____ ____ gals – Mixture: _____ ____ gals

6. Location of Incident (name of site): _____
   ___1/4 ___1/4 ___Sec ___T ___R Highway/Road: _____
   Time of Incident:_____ Date: _____

   Provide a description of the site (water bodies, vegetation, landmarks)
   _____
   _____
   _____
   Distance to picnic/play campground area: _____
   nearest well: _____
   surface water: _____

7. Is there a danger of surface water contamination? ___yes ___no
   Has a pesticide already entered the water body? ___yes ___no
   Name of Stream/Lake _____

8. Is there a danger of ground water contamination? ___yes ___no
   Depth to groundwater: _____
   Elevation above nearest surface water: _____

9. General Soil Description (check one for surface and subsurface soil)

Surface ☐ Dark Colored, Organic, Rock Free
☐ Medium Textured
☐ Light Colored, Rocky

Subsoil ☐ Dark Colored, Organic, Rock Free
☐ Medium Textured
☐ Light Colored, Rocky

10. List Agencies Notified

FWP Authority _____ When _____
Local Authority _____ When _____
State Authority _____ When _____
Federal Authority _____ When _____
Other Authority _____ When _____

11. Site Sketch

12. Describe Incident: _____
_____

13. Public Contact/Comment During Incident: _____
_____

14. Name: _____ Date: _____

APPENDIX I

APPENDIX I. THREATENED, ENDANGERED AND SENSITIVE SPECIES INFORMATION

GRINDELIA HOWELLII Steyermark
Howell's Gumweed Asteraceae (Sunflower Family)

MONTANA COUNTIES: Missoula, Powell

PHYSIOGRAPHIC DISTRIBUTION: Blackfoot and Clearwater river drainages

U.S. FOREST SERVICE STATUS: Sensitive

NATIONAL FOREST(S): Lolo, Idaho Panhandle, Flathead, possibly the Beaverhead

HABITAT: Various disturbed and natural habitats, including roadsides, grazed pastures, pine plantations, forest openings, river terraces, and native grasslands, (2400-3900 ft

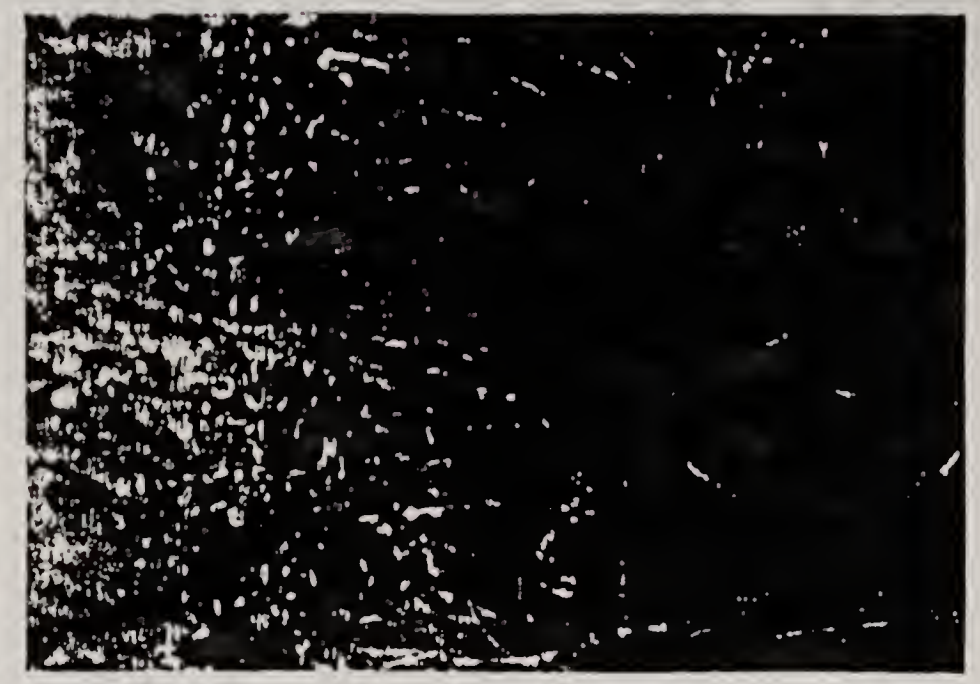
DESCRIPTION: Howell's gumweed is a short lived perennial with stems up to 80 cm (32 in) tall that are woody at the base, and clustered on a taproot. The basal leaves are lance shaped, broadest toward the tip, and up to 20 cm (8 in) long. The clasping stem leaves are reduced in size and entire margined, or with shallow, ill-defined teeth. The foliage is resinous and glandular. The stem is glandular haired, and usually also has some long, soft hairs. The flowering heads are borne in a terminal, open, leafy hillcrest cence. The numerous, narrow, involucre bracts are resinous and have green, recurved tips. The yellow rays (petal like outer flowers) are about 1 cm long. The heads are 8-25 mm across the top (not including the rays). The seeds (achenes) are flat on the top, with a few stiff bristles that are easily removed

BLOOMING SEASON: Flowering in July and August

SIMILAR SPECIES: This species is very similar to *G. nana* and *G. squarrosa*. It is distinguished by having glandular, and often hairy rather than glabrous, stems

Grindelia howellii Photo by: Steve Shelly

Grindelia howellii Photo by: Steve Shelly



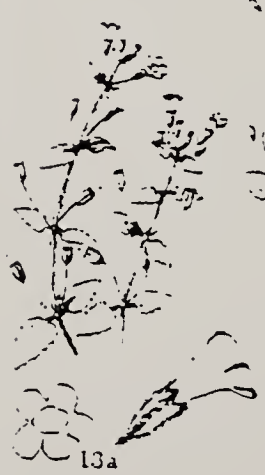
15b

Mimulus L. Monkey-flower

Fls axillary: calyx strongly 5-angled, the midveins to the gen rather short lobes prominent and often raised: corolla = bilabiate, yellow to purple or red, the upper lobes external in bud; stamens 4, didynamous, all with well developed anthers; stigmas gen distinct, or sometimes marginally connate into a funnelf structure: caps loculicidal, sometimes splitting across the septum; seeds ∝; herbs (ours) with opp. entire or toothed lvs. (Diminutive of L *mimus*, a mimic).

12a

12b



13a

14a

15a

15b

1b Pls ann. without stolons or rhizomes; other features various
9a Corollas yellow, often marked with red: peds elongate, gen > calyx: corollas except sometimes in no 14) gen deciduous before withering; septum of caps remaining intact, or splitting only above the middle; spp. gen of moist or wet places of middle and lower elev (to high elev in no 14)
10a Corolla strongly bilabiate, the lower lip evidently > upper and strongly deflexed from it: corolla at least 8 mm; principal lvs of fairly broad form and gen petiolate
11a Upper calyx tooth obviously > others; ann forms of no 4 (esp var. *depauperatus*) keyed with the per spp.
11b Upper calyx tooth ca = others, or smaller
12a Corolla pubescent on the palate, sometimes finely red-dotted, but without a prominent blotch; calyx teeth all = alike, gen acute: E Cas in Ore, Wn, and n Ida; Wn m. 9 M. washingtonensis Gand.
12b Corolla glab, bearing a prominent maroon blotch at base of lower lip; upper 3 calyx teeth acute, lower 2 longer and rounded: shady places, esp in moss mats on cliffs, in and W Cas: chickweed m. 10 M. alsinoides Dougl.
10b Corolla only slightly bilabiate, the lower lip only slightly > upper and not much deflexed from it; corolla often < 8 mm; lvs diverse
13a Lvs abruptly contracted to the petiole: herbage gen evidently viscid-pubescent, or sometimes only shortly and inconspicuously so: corolla 6–14 mm; gen E Cas; many RM pls, called var. *membranaceus* (A. Nels.) Grant, are small, few-fld, and thin-lvd, with relatively long petioles and inconspicuous pubescence; purple-st m. 11 M. floribundus Lindl.
13b Lvs tapered to the petiolar or sessile base; herbage finely glandular-puberulent
14a Corolla 8–16 mm, gen 2–3 times as long as calyx: peds gen 1–1.5 cm at anthesis, tending to become arcuate-spreading or strongly divergent in fr: e base of Cas, from s Wn s; Pulsifer's m. 12 M. pulsiferae Gray
14b Corolla 4–8 mm, slightly > calyx: peds shorter, < 1 cm at anthesis
15a Lvs gen rather narrowly elliptic or rhombic-elliptic, gen short-petiolate; calyx teeth = acute: fr peds tending to be loosely ascending; moist, open places in valleys and plains E Cas, not reaching Mont; short-fld m. 13 M. breviflorus Piper
15b Lvs narrower, linear to narrowly oblong or oblanceolate, sessile or the lower short-petiolate; calyx teeth tending to be rounded-mucronulate: fr peds tending to be widely spreading, with suberect tip; open, moist to dry places at various elev: Mt Adams, Wn, and s; Suksdorf's m. 14 M. suksdorfii Gray

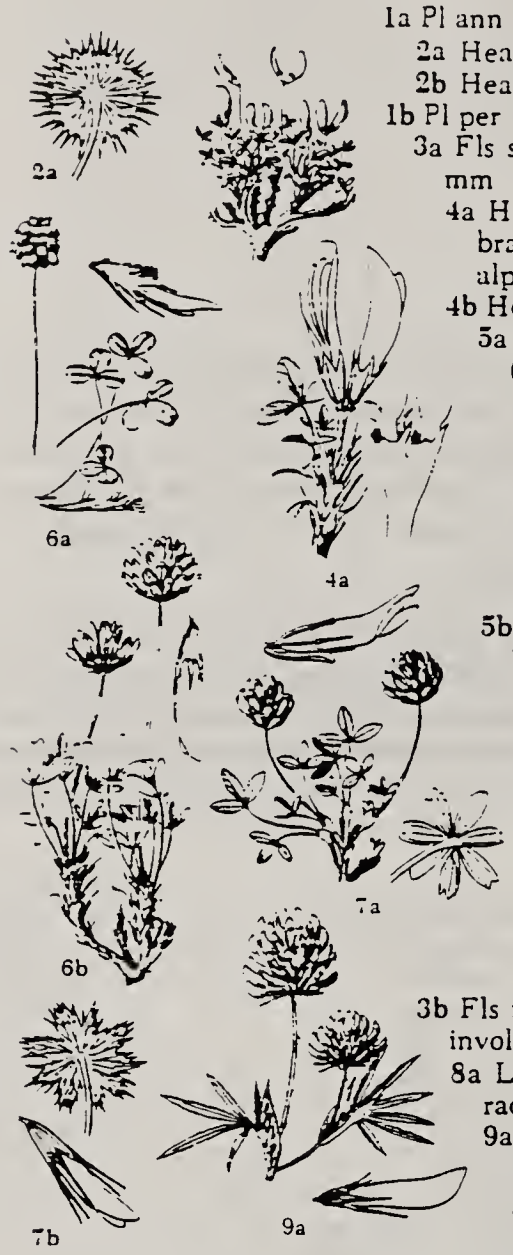
Cyperus L. Flatsedge; Cyperus

Spikelets several–many, in 1 or gen several capitate to spicate clusters, the terminal cluster gen sessile or nearly so, the others borne on ± elongate rays from axils of sheathless, lfy involucral bracts; scales of spikelet arranged in 2 vertical rows; fls ☿, borne singly in axils of the scales; perianth none; stamens 3 (1–2); style bifid or more often trifid, achene accordingly lenticular or trigonous; ann or gen per herbs with mostly triangular, solid sts, lvs with closed sheath and gen elongate, grasslike bl. (*Gr Kypeiros*, the ancient name).

1a Spikelets borne in very short, ± capitate clusters with a very short rachis; pl ann; rachilla wingless; stamens 1 or 2, rarely 3
2a Pistil bicarpellate; stamens 2 (3); scales gen 2–2.5 mm, straight, blunt; pl 0.5–2 (3) dm; wet places, lowl, tolerant of alkali; widespread in US and s Can, but more common e, and rarely collected in our area, s to S Am; shining f. or c. 1 C. rivularis Kunth

Trifolium L. Clover; Trefoil

Fls in pedunculate, ± capitate spikes or racemes, often involˊ papilionaceous, white, yellow, or pink to red or purple; calyx 5-toothed, teeth entire to 3-fid; corolla withering-persistent; stamens 10, diadelphous; pod globose to elongated, gen included in calyx, indehiscent, 1–several-seeded; ann or per herbs, often rhizomatous, with palmately to semipinnately 3-foliolate (sometimes palmately 4–9-foliolate) lvs and membranous to foliaceous stips. (L name, referring to the trifoliolate lvs).

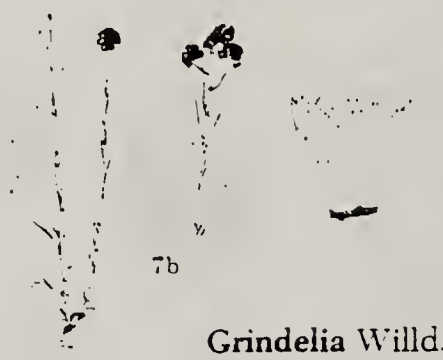


1a Pl ann
  2a Heads invol — Group I, lead 11a
  2b Heads not invol — Group II, lead 18a
1b Pl per
  3a Fls subtended by an invol, bracts 1–4 (–12), distinct to connate, 0.5–2 mm
    4a Heads 1–4-fld; pl 1–3 cm, densely matted, strongly taprooted; invol bracts gen 1–4; fls lilac-purple, aging brown, 15–22 mm; alp or subalp in RM; sw Mont to NM; dwarf c. 1 T. nanum Torr.
    4b Heads several-fld; pl mostly much > 3 cm
      5a Pl evidently pubescent, esp on calyx
        6a Calyx inflated and bladdery in fr; pl rhizomatous, not strongly pubescent except on calyx, 5–30 cm; fls 4–6 mm; European weed in waste places; Wn, Ore, and Ida in our area; strawberry c. 2 T. fragiferum L.
        6b Calyx not inflated or bladdery in fr; pl strongly pubescent, matted, taprooted, 1–3 cm; fls 10–20 mm; alp and subalp slopes; RM, c Mont to Colo and e Utah; whip-root c. (*T. uintense*) 3 T. dasyphyllum T. & G.
      5b Pl glab or subglab, at least on calyx
        7a Pl matted, taprooted, 1–5 cm; heads on scapelike peduncles; invol bracts 6–12, distinct, entire-margined; fls 11–22 mm, dark reddish-purple, aging brown; subalp to alp meadows and stream banks; RM, Mont and adj Ida to NM and e Utah; Parry's c. (*T. montanense*) 4 T. parryi Gray
        7b Pl lfy-std, rhizomatous, mostly 10–30 cm; heads axillary on short peduncles of lfy sts; invol bracts 8–12, connate, margins toothed; fls 10–18 mm, reddish to purple, often white-tipped; meadows and stream banks to coastal dunes; BC to Cal and Mex, e to Ida, Colo, and NM; springbank c. (*T. fimbriatum*, *T. heterodon*, *T. spinulosum*, *T. willdenovii*) 5 T. wormskjoldii Lehm.
  3b Fls not subtended by a true invol, but sometimes stips of upper lvs = invol-like
    8a Lflets commonly > 3; fls gen 30–100 per head, mostly > 18 mm; rachis of head not prolonged beyond upper fls
      9a Lflets linear to lanceolate, acute; calyx pubescent but not plumose; fls bright reddish-lavender to orchid, 18–22 mm; dry grassy hillsides just below ponderosa pine woodl; known only from Swakane Canyon, Chelan Co, Wn; Thompson's c. 6 T. thompsonii Morton
      9b Lflets oblanceolate to obcordate; calyx teeth plumose; fls pinkish to pinkish-rose, 22–28 mm; rocky places in sagebr des to ponderosa pine woodl; e Cas, sc Wn to Nev, e to w Ida; big-head c. (*T. macrocephalum*) 7 T. macrocephalum (Pursh) Poiret
    8b Lflets mostly 3, if > 3 then either fls mostly < 30 per head and < 15 mm, or rachis of head extending well past upper fls
      10a Calyx glab or only sparsely pubescent with scattered hairs — Group III, lead 28a
      10b Calyx strongly pubescent to villous or plumose — Group IV, lead 35a

Group IV

35a Heads 50–200-fld, sessile or with peduncles < subtending lvs; stips of upper lvs forming a false invol; fls deep red, 15–20 mm; European, often cult, now fairly widely intro; red c. 35 T. pratense L.
35b Heads sometimes few-fld, pedunculate, either peduncles > lvs or upper stips not invol
  36a Peduncles mostly < lvs; lflets thick and leathery, gen not > 2.5 cm and with < 30 serrations; pl seldom > 1.5 dm; heads gen < 15-fld; fls white to pink, 8–14 mm; mostly dry soil of sagebr des to ponderosa pine for; ne Ore to ne Cal, e to Mont, NM, and Ariz; hollylf c.; ours the var. *plummerae* (Wats.) Martin 36 T. gymnocarpon Nutt.

T. gymnocarpon



white c.; ours is var. *thermale* (E. Nels.) Cronq. (*G. t.*)

7 **G. microcephalum** Nutt.

7b Ann or bien; lvs merely adnate-aur, often broader than in no 7, sometimes oblong or lanceolate; pls more copiously and loosely tomentose than no 7; invols gen with a more yellowish cast, tending to be grouped in 1 or a few dense glomerules; widespread cordilleran sp., sometimes weedy, gen in moister soil than no 7; cotton-batting pl 8 **G. chilense** Spreng.

Grindelia Willd. Gumweed; Gumplant; Resinweed; Grindelia

Heads radiate or occ discoid, the rays gen 10–45, ♀ and fertile, yellow; invol ± resinous or gummy, its bracts firm, herbaceous-tipped, imbricate or subequal; recep flat or convex, naked; disk fls yellow, the inner and often also the outer sterile; anthers entire or nearly so at base; style brs flattened, with marginal stigmatic lines and an externally hairy, lance-linear or occ very short appendage; achenes compressed to subquadrangular, scarcely nerved; pappus of 2–several firm deciduous awns, often ± serrulate; ann, bien, or per herbs, ours all gen < 1 m, with alt, ± resinous-punctate lvs and several or ∝ medium-sized to rather large heads, the disk in ours 1–3 cm wide; our spp. gen fl midsummer to fall. (David Hieronymus Grindel, 1776-1836, Russian botanist).

1a Heads discoid; bien or short-lived per, glab; lvs entire or with some small teeth, narrow, seldom > 10 × 1.5 cm; invol nearly of no 5; gen in gravelly or sandy places along streams; c Wn and extreme n Ida, and down the CR to Portland; CR g. *G. nana* var. *discoidea*.

1 **G. columbiana** (Piper) Rydb.

1b Heads radiate

2a Tips of invol bracts loose or spreading, but not reg reflexed; invol only slightly or moderately glutinous; herbage ± villous to sometimes glab; per; rays gen 10–35; W Cas; WV g., PS g., 2 vars. 2 **G. integrifolia** DC.

a1 Rays short, gen 8–12 mm; various nonmaritime habitats in PT, from s VI to s WV var. **integrifolia**

a2 Rays longer, gen 12–20 mm; heads ave a bit larger than in var. *integrifolia*; salt marshes and rocky shores, coastal, Alas to n Cal, common about PS (*G. stricta*) var. **macrophylla** (Greene) Cronq.

2b Tips of invol bracts (at least the middle and outer) reg reflexed; invol often = strongly resinous; herbage glab except in no 3; chiefly E Cas

3a St glandular and = villous, at least in infl; prob bien; heads of no 5; n Ida and adj Mont, rare; Howell's g. 3 **G. howellii** Steyerm.

3b St essentially glab; widespread spp.

4a Rays gen 12–25, rarely more on some heads of robust pls; lvs entire or sharply toothed, not at all callous-serrulate; invol seldom strongly resinous; achenes gen with 1 or more short knobs on apical margin; per; common in e Ore and Wn and adj Ida, less common in Mont; low g.; we have 2 vars. 4 **G. nana** Nutt.

a1 Heads relatively small, the invol to ca 1 cm high, the disk to 1.5 cm wide; invol bracts relatively short-tipped; pls relatively small and narrow-lvd; e Wn and adj Ida, s to Union Co, Ore var. **nana**

a2 Heads larger, the invol 1–1.7 cm high, the disk to 2.5 cm wide; green tips of invol bracts longer; more generally distributed, but not in range of var. *nana* var. **integrifolia** Nutt.

4b Rays gen 25–40, occ fewer on some heads of small pls; lvs reg callous-serrulate to sharply toothed or entire; invol strongly resinous; achenes gen without apical knobs, bien or short-lived per; common in Mont and Ida, less common w; resin-weed, curly-cup g., we have 3 vars. 5 **G. squarrosa** (Pursh) Dunal

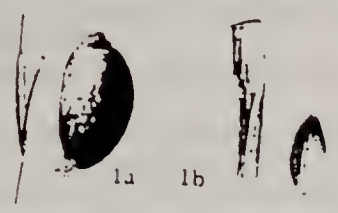
a1 Lvs entire or remotely serrulate, or especially the lower coarsely and irreg toothed or incised; gen short-lived per, native *G. perennis*) var. **quasiperennis** Lunell

a2 Lvs closely and evenly serrulate or crenate-serrulate; gen bien, intro in our range

b1 Upper and middle lvs 2–4 times as long as wide, gen ovate or oblong var. **squarrosa**

b2 Upper and middle lvs 5–8 times as long as wide, gen linear-oblong to oblanceolate (*G. s.*, var. **serrulata** (Rydb.) Steyerm.

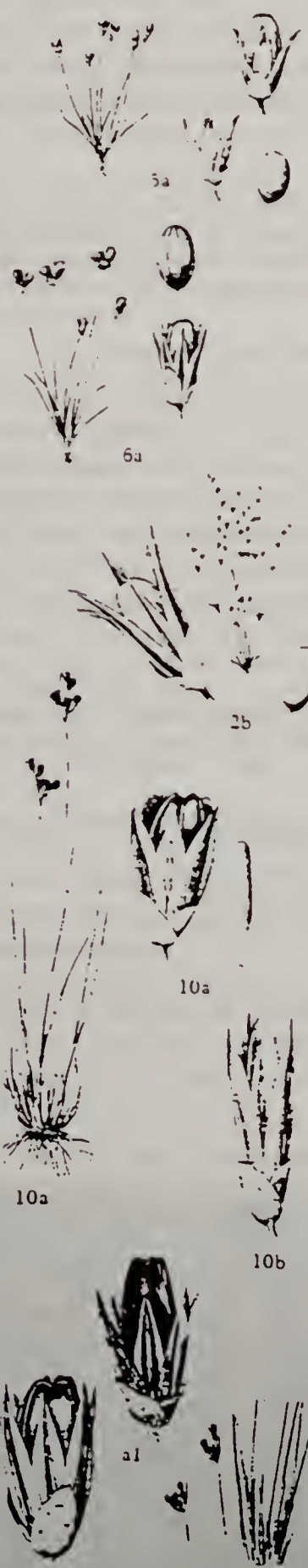
Fls small, capitate to cymose or pan: perianth greenish to brown or purplish-brown, the segms (tepals) in 2 rather similar series of 3 each: stamens 3 or 6 (rarely only 1 or 2); pistil 3-carpellary, stigmas linear; style 1; ovary superior, 1- or 3-celled; fr caps, 3-valved, with 3 or with ∝ seeds; seeds often appendaged at 1 or both ends; ann or per, often rhizomatous herbs with simple, mostly terete sts and alt, terete to grasslike lvs with open or closed sheathing bases.



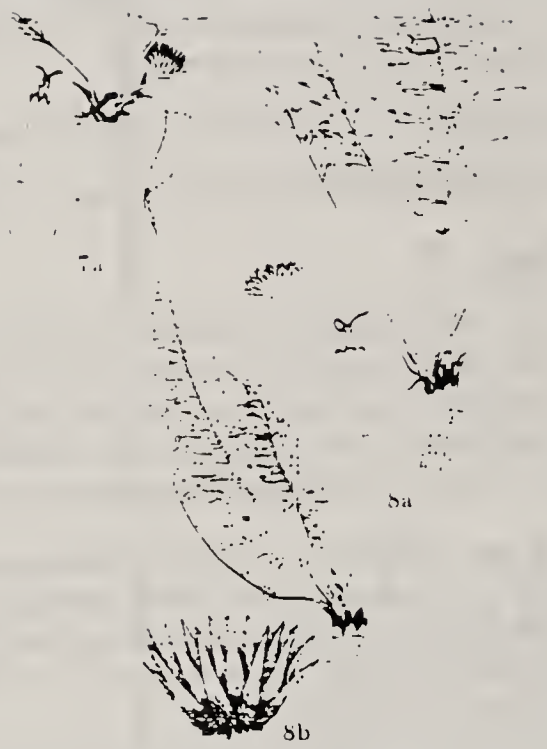
1a Seeds 3; lvs with closed sheaths, the bls often with long straight marginal hairs ..... Luzula
1b Seeds ∝; lvs with mostly open sheaths, the bls rarely at all hairy ..... Juncus

Juncus L. Rush

Fls few (rarely only 1) to ∝ in a terminal, essentially cymose, open and pan-like to greatly congested infl, sometimes in 1 – ∝ capitate clusters, lowest (involl) bract of infl from greatly elongate to reduced, flat to terete, when terete the infl often seemingly lateral on the st; stamens gen 6 or 3, rarely only 1 or 2, filaments from < to much > the anthers; caps 1-celled with 3 parietal placentae or placentae intruded and caps 3-celled; seeds ∝, gen = fusiform, often appendiculate at 1 or both ends, faintly areolate or reticulate; ann or per, caespitose to strongly rhizomatous herbs with terete to flattened, lfless to lfy fl sts; lvs sheathing at base, the sheath often extending upward on the sides at the juncture with the bl, the projections rounded to pointed (termed auricles, but rarely extending outward as do the aurs of the grass lf); bls from terete to laterally or dorsiventrally flattened, often septate within. (Classical Gr name for the rush).



1a Pls ann, gen diminutive, much < 1 dm (except *J. bufonius*); lvs narrow, often involute, rarely > 1 mm broad
2a Pl rarely as much as 4 cm, scapose, the fls 1–2 (3) in a terminal head on a naked fl st; stamens 3
3a Bracts lacking at base of the single terminal fl; known from Harney and Lake cos, Ore, and Gooding Co, Ida, and not improb within our range in Ore or Ida ..... J. abjectus Herm.
3b Bracts 1 or 2, present at base of the 1–3 fls
4a Bracts single, truncate, scarcely 0.5 mm but much broader, nearly surrounding base of the solitary fl; tepals gen at least 3 mm; presently not known n of Lake Co, Ore, but possibly reaching our area ..... J. uncialis Greene
4b Bracts mostly 2, if single then acute to acuminate and not surrounding base of the perianth, at least 1 of them gen almost 1 mm
5a Bracts very unequal, upper one ca 1 mm, lower one much reduced or even lacking; seeds very indistinctly reticulate to smooth; caps thin-walled, ca 0.5 mm > the narrowly lanceolate tepals; fls 1 per peduncle; mud flats, vernal pools, and moist to wet meadows, Klickitat Co, Wn, and from Columbia Co, Ore, s through WV to Josephine and Lake cos, widespread and largely mont in Cal; dwarf r. *J. uncialis*, misapplied) ..... 1 J. hemiendytus Herm.
5b Bracts subequal, mostly 1–1.5 mm; seeds rather prominently reticulate or ridged; caps rarely > tepals; fls often > 1 per peduncle
6a Seeds prominently ridged lengthwise and less strongly cross-lined; caps ca = tepals; tepals 2.5–3.5 mm, abruptly acute or short-acuminate, not minutely roughened, damp or wet areas from open fields to mont meadows at medium elev, VI, along CR, Klickitat Co, Wn, and Columbia and Hood R cos, Ore, s through WV and sw Ore to s Cal; Kellogg's r. (*J. brachystylus*, *J. triformis* var. *b*,) ..... 2 J. kelloggii Engelm.
6b Seeds not prominently ridged lengthwise; caps scarcely 3/4 as long as tepals; tepals gradually narrowed to acicular, spreading and minutely roughened tips; known in Ore only from Harney Co, but possibly n into our area ..... J. capillaris Herm.
2b Pls gen > 4 (3–30) cm; fls gen lateral as well as terminal on st, stamens 6; tepals 3–7 mm; seeds apiculate at each end; moist areas gen, from near sea level to midmont, throughout much of N Am, Eurasia; a bad garden weed w Cas; toad r. *J. sphaerocarpus*, misapplied) ..... 3 J. bufonius L.
1b Pls per, gen at least 1 dm; lvs often much > 1 mm broad
7a Infl apparently lateral, lowest involl bract terete, erect, apparently a continuation of the st
8a Fls gen 1–4 (6–7) per st; involl bract rarely as much as 5 cm; caps ca = or slightly > the perianth; pl alp (or subalp)
9a Uppermost of the basal sheaths of the st with a well-developed bl mostly 2–7 cm; caps sometimes acute
10a Caps retuse; tepals acute, 4–5 mm; pl 2–3 (4) dm; RM, sc Mont to Colo; Hall's r. ..... 4 J. hallii Engelm.
10b Caps acute; tepals acuminate, 6–7 mm; pl 0.5–3 dm; BC s, in Cas and OM of Wn, to Cal, e to RM, sw Alta to Colo; Parry's r. (*J. drummondii* var. *p*.) ..... 5 J. parryi Engelm.
9b Uppermost of the basal sheaths bladeless or with a bl scarcely 1 cm; caps retuse; tepals (4) 5–7 mm; Alas to Cal, in both OM and Cas, e to RM from Alta to NM; Drummond's r.; 2 vars. ..... 6 J. drummondii E. Meyer



gen mere linear bracts, sometimes toothed or pinnatifid, or wanting; irreg distributed E Cas, to Cal and Colo, but absent from Ore; Hooker's b.; ours chiefly in 4 copiously intergrading vars. 9 **B. hookeri** Nutt.

a1 Invol strigose or sericeous to hirsute or hispid, scarcely woolly

b1 Lvs and invol sericeous or sericeous-strigose, the lvs often only once pinnate; pls dwarf; Klickitat Co, Wn **var. hookeri**

b2 Lvs glandular and hispidulous, gen > once pinnate; invol sparsely hispid or hirsute-hispid; pls larger; chiefly SR plains, to Nev and Utah, but also near Yakima, Wn **var. hispidula** (Sharp) Cronq.

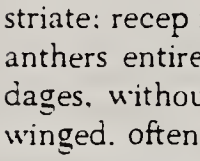
a2 Invol = woolly

c1 Pls relatively large and robust, with broad, gen uncut lf segms; Adams, Gem, and Wn cos, Ida **var. idahoensis** (Sharp) Cronq.

c2 Pls smaller, and with more-dissected lvs, but not so small as var. *hookeri*; e Wn, but not Klickitat Co **var. lagocephala** (Sharp) Cronq.

Bellis L. Bellis; Daisy

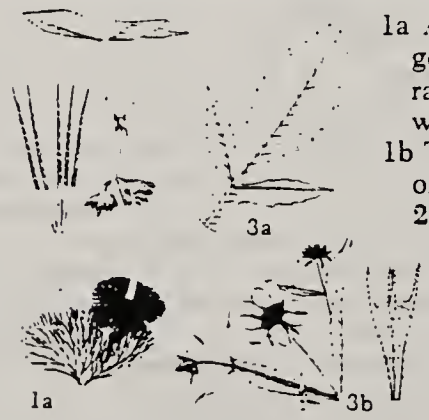
Heads radiate, the rays ♀, white to pink or purple; invol bracts herbaceous, =; recep conic, naked; disk fls ☿, yellow; style brs flattened, with introrsely marginal stigmatic lines and short, deltoid or ovate, externally short-hairy appendages scarcely longer than broad; achenes compressed, gen 2-nerved; pappus wanting; ann or per herbs, scapose or nearly so, with solitary heads. (L *bellus*, pretty).



B. perennis L. English d., lawn d. Spreading-hairy per; lf bls elliptic or obovate to orbicular, toothed, to 4 × 2 cm, = or > petiole; scape 5–20 cm; disk 5–10 mm wide; rays ∝, ca 1 cm or less; weed in lawns and waste places, adventive and = estab across n US, in our range chiefly W Cas; fl Mar–Sept.

Bidens L. Beggar-ticks; Beggars-tick; Bur-marigold; Sticktight

Heads radiate or discoid, the rays if present neutral (♀), yellow, seldom white or pink; invol bracts biseriate and dimorphic, the outer = herbaceous, often very large, the inner membranous, often striate; recep flat or a little convex, chaffy throughout, its bracts narrow, flat or nearly so; disk fls ☿; anthers entire or minutely sagittate; style brs flattened, with externally hairy, gen short appendages, without well marked stigmatic lines; achenes flattened parallel to the invol bracts, not winged, often merely compressed-quadrangular, occ almost reg tetragonal, rarely *(B. beckii)* subterete; pappus of 1–6 (gen 2–4) awns or teeth, gen retrorsely barbed, sometimes antrorsely barbed or even barbless, rarely obsolete; ann to per herbs (shrubs), with opp, simple to dissected lvs; fl summer, into fall. (L, meaning two teeth, referring to the pappus).



1a Aquatic per with the submersed lvs filiform-dissected, the emersed ones gen merely serrate; achenes subterete, 10–14 mm, < the 3–6 pappus awns; rays 1–2 cm; ponds and slow streams; e Am sp., intro in Ore, Wn, and s BC; water marigold 1 **B. beckii** Torr.

1b Terrestrial or semi-aquatic ann, without filiform-dissected lvs; achenes flat or compressed-quadrangular, > the 2–4 pappus awns

2a Lvs, except sometimes the lowermost, sessile; outer invol bracts gen spreading or reflexed; rays 4–15 mm, or none

3a Principal lvs deeply tripartite; achenes truncate; rays < 1 cm; VI; VI b. 2 **B. amplissima** Greene

3b Lvs all merely toothed to subentire; summit of mature achenes convex and cartilaginous (unique among our spp. in this regard); rays to 1.5 cm, or none; widespread; nodding b., s. 3 **B. cernua** L.

or hirtellous at least in infl; lvs narrowly linear; lady's b., yellow b. 12 G. verum L.

10b Fls solitary or few in small, rather inconspicuous infls; sts weak, tending to recline or scramble on other vegetation, gen retrorse-scab on angles; corolla 3-lobed or less often 4-lobed

13a Fls solitary or 2–3 at ends of axillary or terminal peduncles which may themselves be borne in 3's; corolla small, gen 1–1.5 mm wide; common, widespread circumboreal sp., small b., small c.; ours is var. *pacificum* Wieg. *G. brandegei*, a depauperate form; *G. subbiflorum*) 13 G. trifidum L.

13b Fls several in small, irreg br, basically cymose infls; corolla larger, gen 2–3 mm wide; gen W Cas and esp coastal (incl PS), occ inl to nw Mont; Pac b. 14 G. cymosum Wieg.

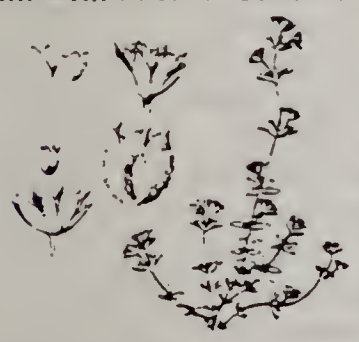
Kelloggia Torr. Kelloggia

Fls ☿, in open, terminal, cymose infls, gen 4–5-merous; calyx teeth short; corolla funnelf-salverf, valvate; ovary 2-celled, with a solitary, erect, basally attached ovule in each cell; style slender, bifid at tip; fr small, dry, indehiscent, covered with hooked bristles as in *Galium*; endosperm well developed; per herbs with opp, entire, sessile lvs and small interpetiolar stips. (Albert Kellogg, 1813–1887, Cal botanist).

K. galioides Torr. Glab, rhizomatous and sometimes also taprooted, sts = clustered, 1–6 dm, lvs lanceolate or lance-linear, gen 1.5–5 cm × 2–15 mm; fls long-ped; corolla pink or white, 4–8 mm, the shortly hispid, ascending-spreading, narrow lobes nearly = the slender tube; stamens and style shortly exserted; fr 3–4 mm, the 2 halves readily separable; widespread at mid to high elev E Cas, also in OM.

Sherardia L. Blue Field-madder; Herb Sherard; Spurwort

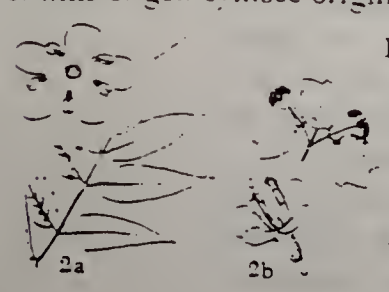
Fls ☿, borne in small heads with a basal involucel of lflike bracts, calyx teeth 4–6, lanceolate, well developed; corolla funnelf, the slender tube evidently > the 4 valvate lobes, ovary 2-celled, with a solitary ovule attached near base of septum in each cell, style bifid at tip; stigmas capitate, fr dry, crowned by the persistent sepals, dicoccous, the carpels indehiscent, endosperm well developed, ann with habit of *Galium*. (William Sherard, 1659–1728, a patron of botany).



S. arvensis L. Sts slender, 0.5–3 dm, spreading-hairy or retrorsely scab, lvs in whorls of ca 6, 0.5–2 cm, stiffly hirsute above, the antrorsely scab, = cartilaginous margins confluent distally into a firm point, heads on axillary and quasi-terminal, naked peduncles, involucel of 7 or 8 (10) shortly connate bracts 4–9 mm; corolla 3 mm, pinkish; fr scab-strigose, 2 mm exclusive of the prominent, pointed sepals. Mediterranean weed, intro W Cas.

CAPRIFOLIACEAE Honeysuckle Family

Fls reg or irreg, ☿ (or the marginal ones sometimes neutral), gamopet, epig; calyx = evidently 3–5-lobed, corolla gen 5-lobed, sometimes bilabiate, the tube sometimes spurred or gibbous; stamens epipetalous, gen 5 and alt with corolla lobes (only 4 in *Linnaea*); pistil 2–5-locular, with 1–several pendulous ovules in each locule, sometimes only 1 locule fertile; stigma capitate or 2–5-parted, the style elongate or obsolete; fr indehiscent, gen fleshy (dry in *Linnaea*); endosperm copious; shrubs or woody vines, less often herbaceous or arborescent pls, with opp (rarely alt or whorled), gen exstip lvs, the stips when present gen small and adnate to petiole; fls in various sorts of infls of gen cymose origin.



1a Style very short or none, stigmas sessile or nearly so; infl br and gen with = ∝ fls, umbelliform to corymbiform or paniculiform, corolla rotate to shortly open-camp; fr drupaceous

2a Lvs pinnately or bipinnately compound; fr with 3–5 small, seedlike stones Sambucus

2b Lvs simple, sometimes lobed; fr with 1 large stone Viburnum

1b Style well developed, = elongate; infl various, of paired fls ending a peduncle, or of short racemes or spikes, or of sessile verticils on an elongate or

Fls reg or nearly
peduncle; corolla
other 2, ovary 3-
dulous normal ov
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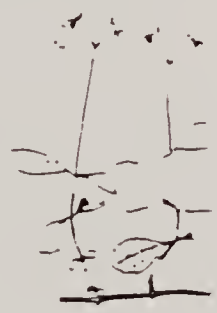
few-toothed to en

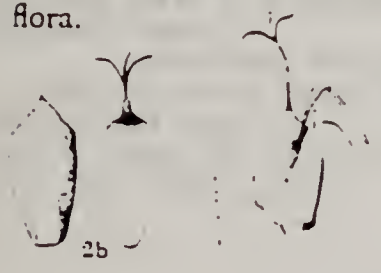


Fls reg or more o
calyx lobes somet
cymules on term
bilabiate, with 4-
2–3-locular, each
stigma; fr a small,
tire lvs. (Adam Lo

CYPERACEAE Sedge Family

Fls much reduced, ♀ or ♂ ♀ (pls then monoecious or seldom dioecious), sessile in spikes or spikelets, apparently or truly axillary to small bracts (scales); perianth of 1–∞ (often 6) short or elongate bristles, or lacking; stamens gen 3, or only 1–2, exserted at anthesis (pls wind pollinated); ovary superior, tricarpellate or less often bicarcellate, the style correspondingly 3-cleft or 2-cleft; ovary 1-celled, 1-ovuled; fr an achene; fibrous-rooted, often rhizomatous herbs, often grasslike, the culm triangular to terete, solid or seldom hollow; lvs mostly 3-ranked and with closed (rarely open) sheath and parallel-veined, typically elongate and grasslike blade, or some or all lvs with reduced or no blade.

Bulbostylis capillaris (L.) Clarke, a small, tufted ann with filiform lvs and few spikelets with spirally arranged scales, no perianth, and 3-angled achenes with a minute tubercle, is a widespread sp. s of our area, and has been reported for Ore, but is not clearly known to be an element of our flora.



1a Achene enclosed or enwrapped in a small bract (perigynium—abbreviation peri) as well as subtended by a scale
2a Peri (gynium) open, with unsealed margins, merely wrapped around the achene — Kobresia
2b Peri closed (except at the tip), though often showing a dorsal suture distally — Carex

Carex L. Sedge

Pls ♂ ♀ or seldom ♂, ♀; fls naked, borne in spikes, each subtended by a gen small and scarious bract (scale); spikes 1–∞, each gen subtended by a large and lfy to much-reduced and inconspicuous bract which may or may not be sheathing at base, or this bract wanting; individual spikes sessile or pedunculate, racemosely arranged in a loose to tight terminal infl, sometimes some of them well removed from the others and axillary to lvs near base of st; spikes unisexual or bisexual, when bisexual the ♂ fls terminal (spikes androgynous) or basal (spikes gynaecandrous) or seldom = intermingled with the ♀ ones; stamens 3 or occ 2; ♀ fls each enclosed by a sac-like bract called a peri (gynium), from the mouth of which the style or stigmas protrude, and subtended by an open scale (the pistillate scale); stigmas 2 or 3 (rarely 4), achene accordingly 2 or 3 (4)-sided; grasslike per herbs with 3-ranked lvs, closed sheaths, and triangular to round, solid sts. (The classical L name).

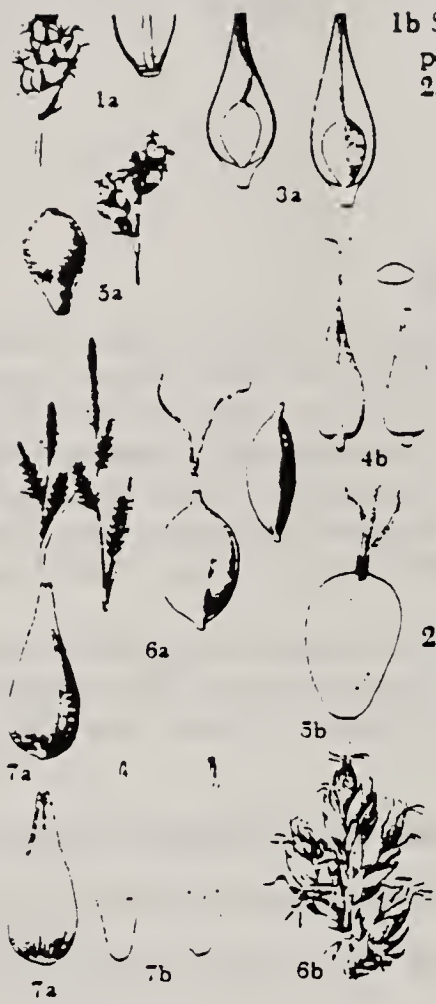
The peri is a highly modified bract on the adaxial side of the ♀ fl; it is wrapped around the fl, its margins being connate, forming an enclosing sac with a minute apical opening. The side of the peri next to the scale (the abaxial side) is called the dorsal side, and the side next to the spike axis (the adaxial side) is the ventral side.

The lowermost lvs are frequently very much reduced, with a short, nongreen bl that is often firm, pointed, and = sheathing, the true closed sheath then often being short or absent. When the lowermost lvs are of this type, with the foliage lvs being borne farther up the st, the pl is said to be aphyllopodic; when the lowest lvs are normally developed, the pl is said to be phyllopodic. The distinction is not absolutely sharp, many spp. being slightly aphyllopodic, with 1–2 reduced lvs at the bottom but with foliage lvs still arising near the base of the culm.

Many characteristically tristigmatic spp. occ have a few distigmatic fls; such specimens should be keyed as being tristigmatic. With few exceptions (esp *C. saxatilis*), our distigmatic spp. only rarely produce any tristigmatic fls.

All students of *Carex* admit that the spp. must often be recognized by small technical differences, esp in the details of the structure of the peri. Often therefore precise measurement of the mature peri and achene may be necessary for accurate identification; immature specimens often are not keyable.

In addition to the spp. formally treated here, the European sp. *C. arenaria* L. has been collected several times on ballast at Portland, Ore. In the key it will fall between *C. siccata* and *C. sartwellii*, differing from both in having the bracts subtending the lower spikes strongly setose-prolonged and surpassing the spike.



1b Spikes 2–∝ (in no 35, 1 spike terminal and 1 or more basal or nearly so); peri never containing a rachilla; small to large pls

2a Stigmas 2 or 3 (4) and the achene accordingly lenticular or trigonous (or quadrangular); if stigmas 2 then the spikes elongate and cylindric (the larger ones seldom under 1.5 cm), or at least some of them evidently pedunculate, or both; peri gen without a dorsal suture

3a Style continuous with the achene and of the same bony texture, not withering, often becoming flexuous or contorted; stigmas 3 and achene trigonous, except in no 20; lvs often septate nodulose
► **Group II** (lead 25a)

3b Styles deciduous; other characters various

4a Stigmas 3 (4) and the achene trigonous (quadrangular); a few lenticular, distigmatic achenes seldom intermingled with the others

5a Peri pubescent (*C. scirpoides*, a ± ♂, ♀ sp., might be sought here, but more properly belongs with Group I, where it is keyed)
Group III (lead 32a)

5b Peri glab (glandular-papillate in *C. californica*)
Group IV (lead 41a)

4b Stigmas 2 and achenes lenticular **Group V** (lead 75a)

2b Stigmas 2 and achenes lenticular; spikes sessile and relatively short (seldom > 1.5 cm), not elongate and cylindric; peri gen with a ± evident dorsal suture, at least distally

6a Spikes androgynous, or pl ± ♂, ♀ and most or all of the spikes unisexual **Group VI** (lead 88a)

6b Spikes gynaecandrous, or some of the lateral ones wholly ♀

7a Peri planoconvex, often with raised margins, but not thin-edged
Group VII (lead 107a)

7b Peri planoconvex or flattened, evidently thin-edged or wing-margined **Group VIII** (lead 117a)

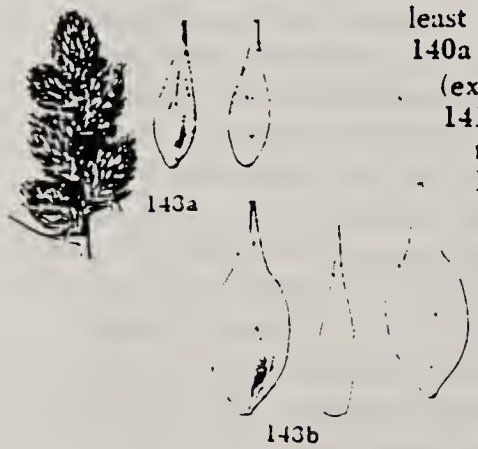
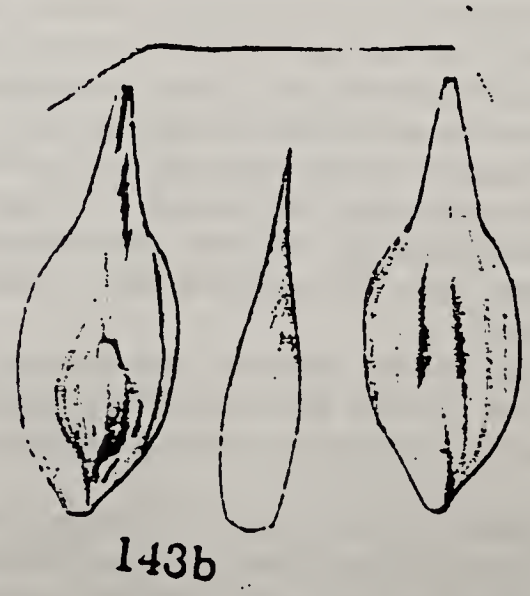
Subgroup VIIIb

139a ♀ scales distinctly shorter and narrower than the peri, largely exposing at least the distal margins as well as the beak of the peri

140a Dorsal surface of the peri relatively few-nerved, the nerves evident (except sometimes in *C. crawfordii*) but < 10

141a Peri 2.5–5 times as long as wide; achenes very narrow, only 0.6–0.8 mm wide

142a Peri either at least 4 mm or > 3 times as long as wide; beak of peri becoming slender and subterete in the distal 0.2–0.5 mm

143a Peri 3.3–4.0 × 0.8–1.0 mm, 3.5–4.8 times as long as wide, planoconvex and not much wider than the achene; achene 1.0–1.3 mm (see lead 132a) 120 C. crawfordii Fern.

143b Peri 4.1–5.5 × 1.5–2.0 mm, 2.5–3.0 times as long as wide, strongly flattened and much wider than the achene; achene 1.3–1.8 mm; moist to wet ground at low elevs, chiefly where humid; widespread N Am sp., W Cas with us; pointed broom s. 128 C. scoparia Schk.